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# INHALATION:

## ITS THERAPEUTICS AND PRACTICE.

### A TREATISE

ON THE

INHALATION OF GASES, VAPORS, NEBULIZED  
FLUIDS, AND POWDERS,

INCLUDING

A DESCRIPTION OF THE APPARATUS EMPLOYED, AND A RECORD  
OF NUMEROUS EXPERIMENTS, PHYSIOLOGICAL AND  
PATHOLOGICAL; WITH CASES.

BY J. SOLIS COHEN, M.D.

*Illustrated.*

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## E R R A T A.

Page 32, 6th line from top, for 1865 read 1866.

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## P R E F A C E.

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INHALATION, especially by the method of nebulization, is at present attracting favorable attention from the profession.

At the annual meeting of the American Medical Association, held in Baltimore, in 1866, a committee, of which the writer was chairman, was appointed to prepare for the meeting of 1867 a report on the Therapeutics of Inhalation. In the preparation of this report, the writer accumulated a quantity of material much too voluminous for that purpose, and determined to incorporate the most valuable portions in book-form, presenting in some detail the historical record of experiments, pathological studies, &c., from which conclusions were drawn for the report. The principal literature on the subject is foreign—for the most part German—the most elaborate work being (*Die Inhalations-Therapie*) by Dr. George Lewin, of Berlin, from which much has been drawn in the preparation of the present volume, besides

which, as will be seen, many other authors have been consulted, as also an extensive file of foreign and American journals; while the private experience of several practitioners in this country has been laid under contribution.

PHILADELPHIA, NO. 127 SOUTH TENTH STREET,

October 1, 1867.



## INTRODUCTION.

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IN examining the literature upon our subject, we find that inhalation has been employed from the earliest ages in Greece, in Rome, in Arabia, and thence, with the extension of medical knowledge, everywhere. Again and again has the method been extensively resorted to, and subsequently fallen into disuse, perhaps into abuse, for at each resumption it has seemed necessary to advance specious reasons accounting for its previous neglect.

Of late, new discoveries in pneumatics have at various periods given an impulse to further investigation of the subject, and at each time with some permanent beneficial result.

Thus the discovery of oxygen by Priestly and Scheele in the middle of the last century, led to experiments upon the economy with "different kinds of air," and atmospheres noxious and innocuous were pressed into the service of therapeutics.

Then, early in the present century, the discovery of the peculiar properties of chlorine and iodine, led anew to examination of the physical properties of volatile substances; and the inhalations of resinous materials, of narcotics, &c., were again brought into medical requisition.

Again, the observed effects of compressed air in certain of the mechanical employments, attracted experiment as to its value as a therapeutic agent.

Finally, the recent discovery of a method of subdividing liquids into a cloud or nebula, and thus utilizing

them to the purposes of inhalation, and enlarging at once its sphere of usefulness, has given a fresh impetus to the study of the Therapeutics of Inhalation, which bids fair to result in the acquisition of new and valuable methods for at least affording grateful relief in those pulmonary affections, to the cure of which, medicine is, unfortunately, inadequate.

The personal attention necessary to insure proper inhalation, even of the most volatile substances, has no doubt debarred many physicians from a resort to the method, in preference to the much easier plan of advising a patient to swallow a draught or a pill; and this, perhaps, is the reason why it has heretofore been found principally in use by a class of practitioners, "who," to use the language of the author of one of our best works on Therapeutics, "inhabit the debatable region between medicine and quackery." Dr. Rogers, in a note to Elliotson's Practice, Philadelphia Edition, 1844, p. 804, says: "A medical man, when he orders a patient to inhale vapors, must give his personal attention to the manner in which it is performed if he wishes to have his intentions efficiently carried out. On one occasion, in a large hospital, when a patient with ulcerated sore throat had been ordered to inhale steam, I found him with a tin inhaler comfortably tucked under the bed-clothes with a cork stuffed into the air-tube. The consequence of this was that the patient was obliged to remove his mouth from the instrument after every inspiration, and after all his laborious efforts the supply of steam was very inefficient. The nurse (in every respect an excellent one), on being questioned as to the use of the cork, very naturally replied that it was 'to keep in the steam;' and added, that she had been in the hos-

pital eleven years and never saw an inhaler used in any other way. There is nothing surprising in all this. Nurses are not expected to understand the principles of pneumatics. On instituting an inspection of the other inhalers in the hospital, every one of them was found duly provided with a cork."

The material collected in the following pages will show that inhalation has at all times possessed the confidence of men in good professional repute. Our various works on Therapeutics and Materia Medica, Copland's Dictionary, and the works on Practice issued in the earlier portion of the present century, give historical lists, more or less complete, of the various authorities who have at times employed inhalations and recommended them, as well as lists of the remedies resorted to. To have presented a complete list in the present volume would have occupied many pages that are devoted to matter more practical, and the writer has been unwilling to furnish an incomplete record. Instead of an extended display of authorities, therefore, reference is made in each appropriate place to those individuals to whom the profession is indebted for having first prominently placed before them the merits of the inhalations of various remedies in certain diseases ; and with regard to the new method of inhaling nebulized fluids, the authorities cited are, as far as possible, authenticated, and credit given to the sources from which information has been derived.

The subject is necessarily incomplete ; the observations made in various directions are not yet sufficiently numerous or corroborative of each other for the deduction of positive conclusions ; and it is to be regretted that the value of a faithful record of unfavorable results

has not attracted a sufficient share of attention from those who have hitherto written on the subject.

Such observations and records of authors, abroad and at home, as have seemed to the writer most valuable from the mass of matter which has accumulated on his hands, are laid before the reader that he may form his own estimate of their value. The writer has endeavored to present the subject as impartially as a decided bias in favor of inhalations would permit.

It may not be amiss here to answer an objection that will often be heard urged against inhalation. It is this: Inhalation being defended on the ground that affected structures are thus subjected to local treatment; and, at the same time, it being impossible to limit the local action to the diseased structures; where, then, the great benefit? We see, however, that the objection holds good in a measure, with regard to medicines given by the stomach; they affect more or less the entire system, though their action may predominate in some one direction; but there is a class of therapists who teach that it is by sustaining those portions of organs still healthy, and protecting them against the extension of morbid processes, which have already imperilled the integrity of part of their substance, or at any rate temporarily impaired their natural functions, that we are able to extend the restorative influence by continuance of molecular action into the very structures diseased, and thus excite them, as far as they are not disorganized or changed, to a return of normal function. Healthy tissues, too, resist the effect of medicines, local or general; thus we can rarely restrict the action of a lotion or a caustic to the diseased structures, the parts immediately adjacent often receive a full benefit from the applica-

tion ; still, that affords no valid argument against the use of such local treatment.

It seems plausible, too, that even when remedies act systemically, we should anticipate better results by impressing first the particular organs designed to be acted upon with any remedy by its passage through the system, than by impressing the system primarily and the affected organ secondarily, by the passage through it of medicated blood-plasma, or modified nerve-force ; besides which, the systemic exhalants are more actively called upon for their emunctorial duties, than are the systemic absorbents for the impression of some special organ ; added to which, the changes which may occur during the progress of the digestion of a medicine may alter its primary effect ; and if any difference has been detected in the effect of any remedy as administered by inhalation or deglutition, it is not illogical to trace the cause, in a great measure, to the digestive process to which it is subjected in the stomach, where the remedies undergo preparation for absorption. We administer remedies for the production of effects known to occur after exposure to the digestive process, and it may be possible that their action would be different were they not thus digested ; at any rate, we act upon such premises, for we diminish the quantity of medicine to be introduced by direct absorption into the body for a certain effect, whether by the skin or by the bronchial mucous membrane ; and therefore, in resorting to inhalatory therapeutics, we must carefully watch the effect of remedies, for it may require much judgment in the selection of a special *materia medica*. One advantage is, that remedies exhibited for inhalation are usually presented in a simply medicinal form, deprived in great

measure of the original (resinous, woody, or other) connecting medium, which is more apt to be preserved as usually administered, while the misfortunes and errors of the elaborate prescriptions of polypharmacists are less apt to be endured by the patient.

The mucous membrane of the respiratory organs has a much greater capacity for absorption than that of the stomach, than which it is much more delicate; and for articles not desirable to be exposed to the solvent principle of the gastric juice, inhalation is at least as advantageous a mode, in many instances, for the administration of appropriate remedies, as the skin or connective cellular tissue. The material inhaled comes directly in close juxtaposition to the blood while in its most vital state, and is thus more promptly and more thoroughly absorbed into the tide of the circulation than when it performs part of the venous circuit before exposure to the inspiratory effort. It is often, too, advantageous that nothing shall interfere directly with the digestive functions.

The promptness with which the respiratory mucous membrane absorbs is well shown in the action of general anæsthetics, and he who is skeptical as regards the facility with which other articles of the *materia medica* are absorbed, can perform upon himself the experiment of taking a certain amount of a narcotic by the stomach, and at another time, under similar conditions of body as well as may be, inhaling a similar amount of the same narcotic in solution, by some of the methods described in the pages of this volume; and, unless he be the subject of some idiosyncrasy, the truth of the matter may safely rest upon his own verdict as to the resulting sensations.

# ON INHALATION.

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## PART I.

### INHALATION OF NEBULIZED FLUIDS.

#### CHAPTER I.

##### NEBULIZED MEDICAMENTS AND THE APPARATUS FOR THEIR PRODUCTION.

EVERY one who has seen a waterfall strike upon the rocks below it, knows how portions of the stream are broken by the concussion into a coarser or finer spray which remains for a time suspended in the atmosphere. A stream of water forced through a narrow tube against a firm resistance will produce the same effect, as we sometimes see in the more remote particles of the water as it is dashed from a building against which an engine is playing. These remote particles are no longer in contact, but are separate molecules, which, as soon as they alight, are condensed into drops.

On this principle, it occurred to AUPHAN, at EUZET-LES-BAINS, in 1849, to break up the mineral water of that watering-place into a fine spray, for purposes of inhalation, by forcing a delicate stream to impinge against the walls of the apartment. The same system was adopted shortly after at *Lamotte-les-Bains*; and subsequently SALES-GIRONS, in conjunction with M. DE

FLUBE, proprietor of the baths at Pierrefonds, a watering-place near Compeigne, and who first suggested the idea of pulverizing liquids without employing a blast of air, constructed an apparatus for converting these mineral waters into the finest possible spray, with the idea of more thoroughly preparing them for the treatment of diseases of the respiratory organs. Sales-Girons read a paper entitled, "*Mémoire sur la Chambre de Respiration nouvelle de Pierrefonds*," before the Hydrological Academy of Paris, on December 8th, 1856; in which he described his inhalatorium, and contended that the spray penetrated deeply into the respiratory tract. Doubts were expressed by many of the members as to the fact of such penetrations, and shortly after, experiments were instituted at the different spas to solve the mooted question.

Sales-Girons' inhalatorium was a chamber seven metres long, four and a half metres wide, and three metres high, in which it was intended that several patients, from one to fifteen, should take inhalations together. During the inhalations the window of the apartment was kept open, and the condensed fluid which accumulated upon the floor was carried off by a waste pipe. The patients were prevented from being wet through by appropriate coverings. A suction pump outside of the chamber drew the mineral water up into a tube, which passed through a water-bath heated to the desired temperature, and then passed into the chamber, where it terminated in a vertical cylinder to the end of which was attached the pulverizer or apparatus for producing the spray. Six fine grooves in the cylinder, controlled by a stop-cock, gave exit to as many strongly compressed streams of mineral water, which, striking with great force against a metallic plate at short range,



were thence distributed in the atmosphere in the form of a fine spray. (*Thérapeutique Respiratoire ; Traité Théorique et Pratique des Salles de Respiration Nouvelles à l'eau Minérale Pulvérisée, pour le traitement des Maladies de Poitrine. Par le Docteur SALES-GIRONS, Médecin-Inspecteur des Eaux Sulfureuses de Pierrefonds, 1858.*)

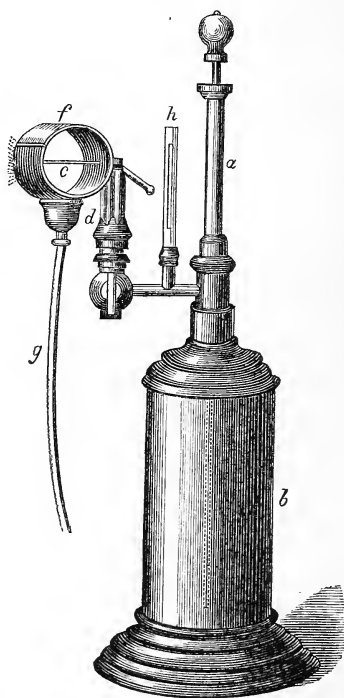
MM. Patissier and Ossian Henry visited the inhalatorium at Pierrefonds, and reported to the Academy of Paris that they were satisfied that the sprays produced at that establishment contained all the elements of the original mineral water. Sales-Girons received a silver medal from the Academy as a recognition of his valuable addition to our therapeutic resources.

Subsequently, SALES-GIRONS devised a portable apparatus, a *pulvérisateur portatif des liquides médicamenteux*, which can be used in any apartment, and through which any medicated liquid can be broken up into spray as fine as that produced in his inhalatorium. A committee consisting of MM. Gavarret, Patissier, O. Henry, and Poiseuille, presented a favorable report on this apparatus to the Parisian Academy of Medicine.

The convenience of such an instrument at once commended itself to those desirous of employing the new method of medication, and gave an excellent opportunity to its adherents and opponents for experiment at their convenience as to the penetration of the spray into the respiratory tract. This apparatus (Fig. 1) was manufactured by Charrière, of Paris, and is known as the first model of Charrière. It consists of a metallic vessel of the capacity of from eighteen to twenty ounces, which is to be filled two-thirds with the liquid intended to be pulverized. In the neck of this vessel

there screws a compression pump (condensing syringe), which, by compressing the air above the liquid, drives the latter through a capillary tube against a convex button, in close proximity, with such force that it is from that point deflected off in a fine spray. A manometer attached to the instrument shows the amount of

FIG. 1.\*

Sales-Girons' Pulverisateur Portatif. (From *Lewin*.)

\* *a*, compression pump; *b*, reservoir; *c*, stream of fluid about to strike the button which is concealed within the drum; *d*, tube with stop-cock; *f*, drum or cylinder in which the excess of spray is condensed; *g*, waste tube to carry off the condensed fluid; *h*, manometer.

pressure employed, the usual pressure being a force of from three to five atmospheres.

The second model of Charrière differs from the first in the reservoir being made of glass, and the glass tube through which the stream of fluid is forced, dipping down into the fluid.

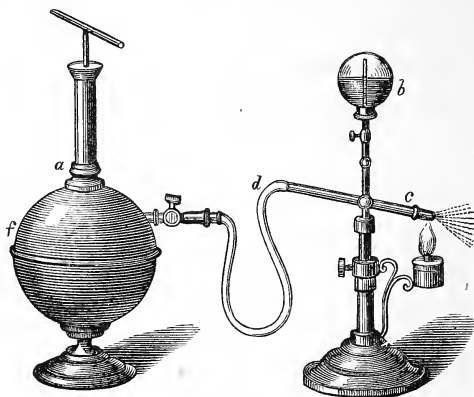
In the third model of Charrière, water pressure is used instead of compressed air; but the pressure soon giving out, it requires to be kept in motion more frequently.

Later, M. MATTHIEU (de la Drôme) constructed a portable spray producer according to a principle suggested by H. Tirman, and which consists in the forcible extrusion of air and fluid at the same time. The principle will be recognized by taking an ordinary syringe after it has just been discharged of its contents, drawing back the piston, and then projecting it forward with force. The fluid remaining in the nozzle will be forcibly ejected with the escaping air, and will be converted into spray; and it may be mentioned in passing that a syringe thus handled, or the little gum-ball douches, now used for nasal, aural, and urethral injections,—taking up but a drop or so of liquid and then propelling it out with great force, affords an excellent method of medicating locally the fauces, tonsils, pharynx, &c. The smaller the opening of the nozzle of the syringe, the finer will be the spray.

Matthieu's apparatus was exhibited to the Parisian Academy of Medicine on the 9th of May, 1859 (*Gazette des Hôpitaux*, 1859, p. 297), and is called by him a Néphogène, or, as we have anglicized it, a nebulizer, which is a more correct name for these instruments than pulverizer or atomizer, for the liquid is not pul-

verized nor atomized, but simply broken up into a cloud or nebula. This instrument (Fig. 2) consists of a Heron's ball, in which the air is compressed. After the

FIG. 2.\*

Matthieu's Néphogène. (From *Lewin*.)

necessary pressure has been produced, on opening the vent, which is controlled by a stop-cock, this compressed air rushes out with great force, and, in escaping, drives before it and with it a small quantity of the desired fluid, which is allowed to drip into the exit tube from a glass globe above; and as it leaves the capillary opening at the extremity, it emerges to all sides in a fine spray; a lamp warms the spray as it escapes.

There are several objections to the employment of this apparatus for inhalatory purposes. A large quantity of compressed air is forced out, and the liquid is driven into the mouth in a straight line, and with such

\* *a*, compression pump; *b*, glass globe containing the fluid to be nebulized; *c*, exit tube; *d*, flexible tube conveying the condensed air from the reservoir to the exit tube; *f*, air reservoir.

force that the ordinary strength of an inspiratory effort cannot deflect it into the air-passages, and the greater part of it condenses upon the pharynx and soft palate, and sometimes strikes these parts with such force (according to Lewin) as to cause spasmodic closure of the glottis and excite spasms of coughing. It is but fair to mention that this instrument was originally intended for administering a spray bath to any individual portion of the body. (*See Gaz. Hebdom.*, May 4, 1860, and [*Matthieu's letter*] May 11, 1860.)

Lambron, Velpeau, and others have constructed similar instruments on the same principle. (*Lewin.*)

SALES-GIRONS also constructed a third instrument, in which the spray is produced by the agency of bristles attached to the circumference of a wheel. As the wheel is rapidly turned, the brushes dip into the fluid to be nebulized, and as they emerge from it strike with force against a ledge, and thence the fluid is disseminated as a fine spray. (*Fieber.*)

LEWIN, of Berlin, has constructed an apparatus with an ordinary suction pump (syringe) which forces the liquid into a reservoir, the air within which is thus compressed, and in its turn becomes a propelling force driving the fluid, by the opening of a valve, out of a very fine aperture, whence it impinges on a convex button, and is thus broken into spray. This apparatus once set in action will continue to work for a considerable time without further pumping.

WALDENBURG (*Die Inhalationen der zerstäubten Flüssigkeiten*, &c., von Dr. L. Waldenburg, Berlin, 1864), has constructed an apparatus with a suction and forcing pump (the same sort of pump that is furnished with Mayer's uterus douche), which draws the liquid

from a second vessel, and then drives it out, through a capillary opening, against a cylindrical drum with a concave plate of metal (à la Sales-Girons). A tube attached to the drum conveys the condensed excess of spray back to the reservoir, so that the same liquid can be used again and again for some time. Waldenburg also conceived the idea of suspending the nebulized spray in connection with the vapor of water; and he adjusted a flask in which the water or desired decoction was made to boil, so that the steam passed through the cylindrical drum of his nebulizer and thus mingled with the spray.

Subsequently he constructed, after a plan suggested to him by REICHENHEIM, a chemist, an apparatus in which the steam and the nebulized fluid was produced at the same time. A convenient vessel was tightly closed by a cork. Through an opening in the cork dipped a wide tube nearly to the bottom of the vessel. The tube gradually narrowing terminated at its bent extremity outside of the vessel in a capillary opening. The vessel, filled nearly full of a watery fluid, being heated, a portion of the fluid is converted into vapor, and, as it cannot escape through the cork, it presses more and more by its continued evolution upon the upper surface of the fluid, and in its escape drives out some of the fluid before it through the exposed extremity of the tube dipping into the vessel. Then by directing the escaping stream against some appropriate resistance, as a convex metallic lens, the simultaneous production of steam and spray may be kept up for a considerable time.

Dr. J. SCHNITZLER (*Wiener Medicinhalle*, 1862, No. 29, Fieber, Lewin et al.) has constructed an apparatus.

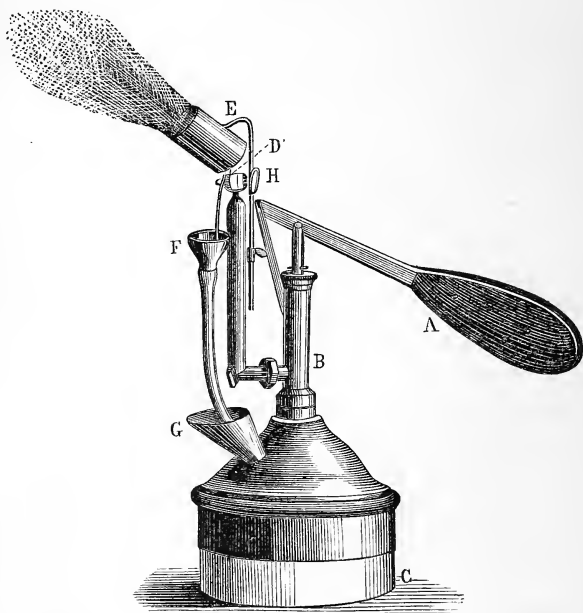
This consists of a stout cylinder of glass, with an air-tight metallic cap and base: the air in the vessel which contains the fluid is compressed by a screw instead of a vertical piston, and when the cock is opened, after a few rapid turns of the screw have produced the desired pressure, the stream rushes out through a capillary tube, and impinges against a lens in close proximity. With this apparatus the lens against which the fluid is nebulized can be held in the mouth of the patient so as to prevent too great a loss of fluid.

FOURNIÉ (*Gazette des Hôpitaux*, July, 1861) has constructed an apparatus composed of a compression pump, and a reservoir with a stop-cock; a glass cylinder with a tube ending in a capillary opening and made of platinum; beneath the capillary extremity of the tube a lens on which the impinging stream is nebulized. In this apparatus also, the lens can be inserted within the mouth and the nebulization take place there.

The most convenient apparatus working by pressure, next to that of Lewin, to be described presently, and for promoting deep inhalations of any fluid which will not be acted upon by metal, is the modification of Sales-Girons, figured on the next page, and manufactured by L. Mathieu (cutler), of Paris. It is readily managed, and produces a more minute spray than any other instrument I have seen employed. An idea of the appearance of the nebula produced may be inferred from the exclamation of a boilermaker of this city, for a friend of whom I was employing an opiate solution at ordinary temperature. He saw me take the cold water from a drinking pitcher and add it to the medicated solution, and, after watching the play of the spray for a few seconds, he burst out, "Well, Doctor,

I'll be hanged! that's the first time I ever saw any one get up steam out of cold water!"

FIG. 3.\*



This apparatus (Fig. 3) is composed of a glass reservoir *c*, in which the liquid to be employed is poured through the little funnel *g*. On compressing the air in the pump *B*, by motion of the lever *A*, the fluid is forced through a small groove in one of the plates

\* *A*, lever; *B*, condensing syringe; *C*, glass reservoir; *D*, joint in which there is a groove through which the stream escapes; *E*, metallic drum, against the concave surface of which the stream becomes nebulized; *F*, waste pipe; *G*, funnel for entrance of fluid; *H*, screw regulating the delicacy of the escaping current of fluid.



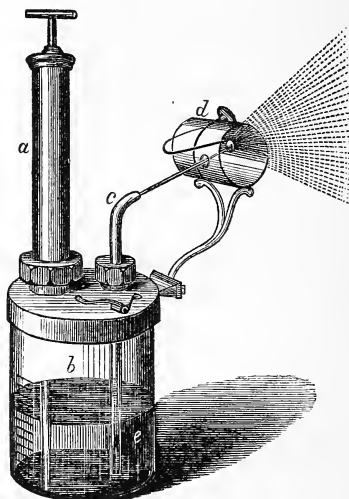
forming the joint D, and, by turning the screw H, the smooth plate is more or less compressed against the groove, thus regulating the fineness of the stream. A stream as fine as the finest hair can be thus secured if the instrument be properly constructed. This stream strikes against the upper portion of the cylindrical metallic drum E, whence it is diffused in a very fine spray. A waste-pipe F, conveys the excess of fluid back into the reservoir. The force with which this little apparatus works can be seen by removing the drum, when the stream will be projected up for several feet, then falling like a fountain. It is said that at a few inches distance the stream can be projected into the skin, thus forming a mode of endermic medication.

All these apparatuses are composed entirely, or in great part, of metal, which limits their employment to such articles as will not chemically react upon them.

This objection is overcome by the very admirable apparatus of LEWIN, of Berlin (Fig. 4), which combines the Sales-Girons' principle of the suddenly-arrested stream, and the Nathanson principle of the distributing current of air. It consists of a strong glass reservoir of the capacity of one-fourth gallon, and graduated in ounces. It is covered by a strong metal cap, in which there are three openings: one for the introduction of the liquid and the subsequent attachment of the condensing syringe; one affords exit to the capillary extremity of a slender tube which reaches to the bottom of the glass; and the third is covered by a spring safety-valve, through which the compressed air may escape after a certain pressure has been produced. The finger is placed upon the capillary extremity of the exit tube until the air in the reservoir has been sufficiently compressed by a few

strokes of the piston, when the finger is removed, and the fluid rushes out with great force and breaks upon a gilded metallic convex button secured in a glass drum,

FIG. 4.\*

Lewin's Glass Nebulizer. (From *Lewin*.)

perforated to admit the stream, and attached by a support to the side of the instrument. The drum is not furnished with a waste-pipe, but is so inclined that the excess of fluid will flow over its edge into any convenient receptacle.

The advantages of this instrument are, that the medicinal solution comes in contact only with glass, or with the gilded button, and therefore any substance desired can be nebulized with it; that the amount of fluid nebulized, as well as the quantity remaining, can be

\* *a*, condensing syringe; *b*, reservoir; *c*, exit tube; *d*, drum.

accurately measured; that twelve or fifteen strokes of the piston is sufficient to secure the escape of fluid for several minutes, thus avoiding the labor of frequent pumping during inhalation.

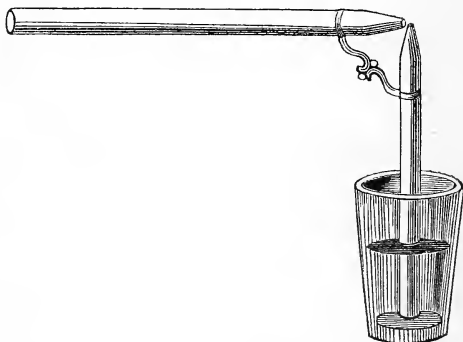
The great objection to the apparatus is its extravagance with the liquid. Where economy is no object, it is the most convenient instrument for office use. If there be allowed to remain in the reservoir any solution which may undergo change, or in which a precipitate may form, the capillary tube may become clogged up, and thus either stop the exit of the fluid entirely, or deflect the stream so that it will not impinge upon the lens. The exercise of care is necessary, therefore, to keep the instrument clean, and to avoid following its use with one medicine, by the use of another which may cause a precipitate.

In 1862, Dr. BERGSON constructed a nebulizing apparatus according to a suggestion of Dr. NATHANSON (*Deutsche Klinik*, 1863, No. 7), which depends upon a physical principle similar to that of Matthieu. This principle is, that a strong transverse current passing over a perpendicular tube will rarefy the air in the top of that tube, and thus draw up any liquid in which the tube may be immersed, the liquid, as it meets the current, being broken into spray. This principle was formerly applied to the cleansing of chimney flues, and quite recently has been employed for pumping bilgewater from the holds of vessels, for distributing the water from fire engines, and for superheating steam by the prompt evaporation of a watery spray forced within a boiler. It has of late years become familiar to every one in our larger cities in the perfume distributors used by the ladies to odorize their handkerchiefs or any other

portion of their attire; and has been introduced into parlors and public places of amusement for the purpose of perfuming the atmosphere. It is also an excellent mode of distributing a disinfecting solution in the atmosphere of a sick-chamber, or the wards of a hospital.

The apparatus, as constructed by Bergson, consists of two tubes at right angles, placed with their extremities together, and so joined that the extremity of the perpendicular tube should stand in front of the axis of the horizontal tube, as seen in the accompanying diagram.

FIG. 5.

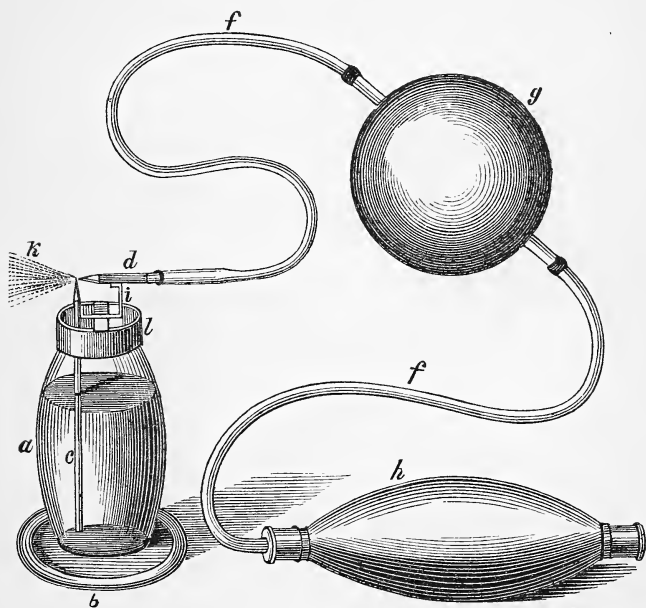


The Bergson Tubes.

If two tubes are thus arranged, and the vertical tube placed in a vessel containing a liquid, and then a current of air be blown from the mouth through the horizontal tube, the transverse current will carry over with it, as it were, the top of the column of air in the vertical tube, which, of course, will force up a current of the liquid to occupy the space of the air; and this continuing, the liquid will at length reach the top, and be blown by the transverse current into a coarser or finer spray.

The fineness of the spray, and, consequently, its facility of ingress into the respiratory tract, will depend upon the minuteness of the extremities of the tubes, principally upon that of the tube dipping into the liquid. If the fluid is to be nebulized by the breath alone, the opening of the horizontal tube must not be too small, otherwise force enough cannot be produced. If the cur-

FIG. 6.\*

Bergson's Apparatus with the Foot Bellows. (From *Lewin*.)

\* *a*, reservoir for fluid; *b*, waiter; *c*, vertical tube; *d*, horizontal tube; *f*, flexible tubing; *g*, air reservoir; *h*, rubber bellows to be compressed by the foot; *i*, joint connecting the Bergson tubes; *k*, nebula or spray; *l*, rim or cap of reservoir to which the nebulizing tubes are attached.

rent is produced by means of a bellows, as the Davison's injecting syringe, the opening of the horizontal tube can be smaller.

For the production of a continuous stream, an air reservoir must be attached to the syringe, and, for this purpose, Dr. Bergson adopted the arrangement of a rubber bellows worked with the foot, connected to the horizontal tube by rubber tubing, in the continuity of which is placed a globular elastic ball as an air reservoir. (Fig. 6.)

Later, Dr. ANDREW CLARKE, of London, adopted smaller bulbs, so that they can be compressed by the hand. It seems to me that the main advantage of the double bulb is, that pumping is thus rendered less laborious, for I do not conceive that there is anything to be gained for purposes of inhalation by the production of a continuous stream; at times, indeed, rather the reverse, for the expiratory current regularly interrupts the inhalation necessarily, and may thus cause a waste of fluid.

These tubes can be formed of metal, glass, or hard rubber. Glass tubes can usually be cleansed by an acid bath, or by nebulizing through them a dilute mixture of sulphuric or muriatic acid and water, and then soaking them in pure water. If they become clogged, the best way to free them is by suction with the mouth at the larger end, so as to draw the obstructing matter back from the small end of the tube. If this does not suffice, or they become clogged while in use, a camel's-hair pencil, or a bristle, or a fine metallic wire, may be employed. A needle will be apt to break off the fine points. The tubes may be formed by drawing out glass tubing over the flame of a spirit or gas light, and then

separating them by a scratch with the blade of a knife; and if they are so joined that the points bear the relation to each other shown in Fig. 5, they will work all right. If the end of the perpendicular tube be below the axis of the horizontal tube, the current will pass over it without impinging sufficiently to take the head off of the air in the vertical tube; and if it be too high, the current will pass to the side, or perhaps pass down the vertical tube, and cause the fluid to bubble up in the vessel. If the perpendicular tube be bent so as to run under the horizontal tube before dipping down into the liquid (see Fig. 9), the tubes can be nicely adjusted by cord or small sections of gum tubing. I was in the habit of forming tubes in this manner for some time before I was aware that the modification had already been adopted by Prof. WINTERICH, of Berlin, and for the same purpose, that of gaining readier access within the cavity of the mouth. Indeed, the idea soon suggested itself to everybody of turning these tubes after properly adjusting their points, so as to gain access to any desired point; and they have been curved into douches for the nares, anterior and posterior, the larynx, the bladder, the uterus, &c.

Dr. Lewin has constructed a very convenient pocket nebulizer after the pattern of Bergson. The rectangular tubes are made of metal or of vulcanized rubber, and joined by a hinge, so that when not in use the two tubes fold one upon the other, and take up but very little space. This is intended for use, as occasion may require, by blowing through the horizontal tube with the breath; but such a method is rather applicable to other purposes than those of inhalation, for the idea of another's breath being blown into one's mouth is dis-

agreeable. To those who care to employ this method, I would suggest the attaching of a few inches of rubber tubing to the horizontal tube, so as to avoid close contact with the face of a patient, and to render the necessary effort less laborious.

Dr. MANS (*Deutsche Klinik*, June 16, 1866, p. 224) has made an improvement on the construction of these tubes of Bergson, which I have found to give at each compression of the pump an amount of spray almost incredible to one who has not seen it, and with very little effort, which, though not more advantageous than the original tubes for purposes of inhalation, inasmuch as these latter produce spray enough, I have found extremely useful in cases of pharyngitis where I wished to employ the spray as a substitute for the gargle; and this especially in the throat troubles of young children, where the instrument which will do the most service in the shortest space of time is quite a desideratum.

In this modification, the apparatus is made out of three tubes instead of two. The third tube communicates with the horizontal tube, and runs down behind the perpendicular tube the depth of a cork, in which the two vertical tubes run. Now, when the medicine vial is tightly corked, part of the transverse current presses on the surface of the liquid, and forces it up the perpendicular tube which dips into it, and thus the force that in the original tube is exhausted in producing the vacuum in the vertical tube, is reserved for the production of spray. I have had instruments thus arranged, duck-billed, after the manner of Winterich, and then curved so as to point to any desired portion of the pharynx, the whole of which, if desired, can be douched by a single pressure of the bulb.



The spray producer of Dr. RICHARDSON, of London, introduced for purposes of local anæsthesia, is constructed upon the same principle as Mans' modification of Bergson's tubes, but upon a different model. In both Mans' and Richardson's instrument the pressure continues for some moments after each compression of the bulb, which is not the case in the Bergson tube.

BERGSON has named his apparatus a *Hydrokomion*, the same name applied in 1829 by SCHNEIDER and RUDOLF WALZ to a sort of shower-bath apparatus, consisting of a reservoir containing water, the air over which was compressed by a pump, and the fluid was driven out through many fine openings. This last-mentioned apparatus, however, was never intended for respiratory purposes.

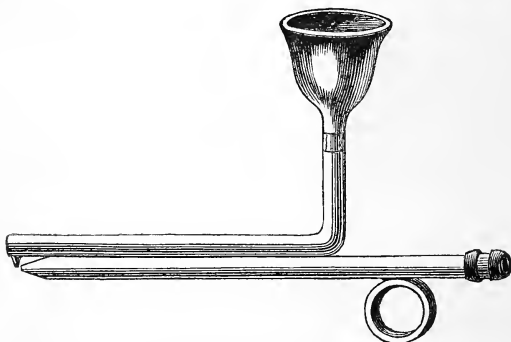
The nebulized current from the Bergson apparatus is more powerful than that from apparatus on the Sales-Girons principle, and it can be at once directed into the mouth. It is therefore most suitable to diseases of the fauces, pharynx, base of tongue, and lingual surface of the epiglottis. For the deeper structures, the other instruments, the spray from which merely hangs suspended in the air, are more suitable, as they are less likely to elude the current of inspiration.

LEWIN, in conjunction with BERGSON, constructed an attachment to his apparatus already described, by which the same instrument could be employed on the Bergson principle, and thus answer every indication. The drum and lens is removed from the apparatus (Fig. 4), and a rod and rings attached, supporting a graduated glass tube terminating below in a very fine opening, placed directly in front of the capillary opening of the tube dipping into the reservoir. The glass tube is

filled with the solution to be nebulized, and drips by gravity in front of the other opening. The reservoir contains nothing but air, and as this is compressed the current escapes, and the nebulization is thus produced. It is really Bergson's tubes upside down.

In May, 1865, I exhibited to the Surgical Section of the American Medical Association a portable instrument (Fig. 7), in which I had turned the Bergson tubes as modified by Winterich upside down, and screwed a little reservoir on to the large extremity of the perpendicular tube, so as to make use of the same principle of gravity.

FIG. 7.



Bergson's Tubes reversed, with the reservoir on top.

Where glass tubes are employed, the extremity of the perpendicular tube is blown out into a reservoir (see Fig. 9). If the fluid drips down too fast, and that it will drip is an objection to the instrument, rendering its employment inelegant at certain times, it can be regulated by the insertion of some porous material, or in the metallic reservoir by diminishing the size of the opening through which the fluid drops into the tube.

This instrument is very useful in many cases. Patients can manage it themselves; if of glass can readily adjust the extremities of the tubes so they will work; and in applying nebulized fluids to the pharynx, &c., the vessel containing the fluid does not obstruct the view into the mouth.

In all these apparatuses thus described, with the exception of the Reichenheim-Waldenburg instrument, the spray, as it emerges, is too cold for general use in acute affections, unless the fluid employed is first warmed, or the spray produced and passed over a spirit-lamp, as in the apparatus of Matthieu, Fig. 2.

It was, therefore, a happy idea of Dr. SIEGLE, of *Stuttgart*, to employ steam as the motive power with the Bergson tubes, instead of compressed air, thus saving to the patient the necessity of an assistant, or the labor of frequent pumping, and securing a more constant nebulizing force than can be produced by the pump, from which the force gradually diminishes unless renewed.

Siegle attaches the horizontal tube to a small boiler in which water is placed, and as the steam evolved escapes through the tube, it creates the transverse current necessary to draw the fluid from the reservoir up the perpendicular tube, and then nebulizes it in the manner already described. The only possible objection to steam as a motive power is that the nebulized fluid is always mixed with a certain amount of steam, which it is possible, but hardly probable, might sometimes prove objectionable. The largest portion of the steam escapes in the surrounding atmosphere; very little is mixed with the spray; too little to prove objectionable. How small this quantity is will be shown hereafter.

Another motive power which has been applied to this purpose during the past year, is the evolution of carbonic acid gas from a mixture placed in a vessel to which the horizontal tube is attached. This is the idea of a young French physician, whose name I cannot recall.

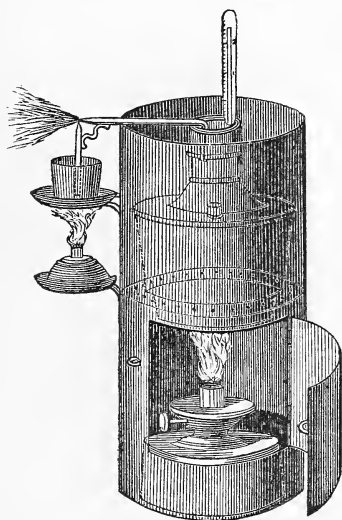
Dr. G. J. ARNOLD, of Roxbury, describes (*Boston Med. & Surg. Jour.*, Dec. 27th, 1866, p. 434) an apparatus in which he employs hydrostatic pressure as the propelling power. The horizontal tube of a Bergson apparatus is connected with the upper portion of an air reservoir by means of a stop-cock and rubber tubing; at a higher elevation is placed another reservoir filled with water; as the water from the latter flows into the lower portion of the air reservoir, the air within it is compressed, and when sufficient pressure has been obtained, the stop-cock is opened, and the compressed air escaping through the horizontal tube, produces the nebulization.

Siegle's boilers are made either of metal or of glass, and each one, before it leaves the manufacturer, is tested to bear a pressure of two atmospheres. The boiler is furnished with a safety valve to avoid explosion, and with one of Collardeau's thermo-barometers, gauged to two atmospheres, in order to designate the pressure, which is regulated by raising or lowering the flame of the lamp by means of a screw acting on the wick. A stand sliding on the outside of the apparatus sustains the reservoir of the fluid to be nebulized by it; and below this another stand supports a small spirit-lamp, in order to raise the temperature of the liquid in the vessel above if necessary. For office use the apparatus may be furnished with a gas lamp, which is more

convenient and less expensive, and a large boiler can be made to receive several sets of the Bergson tubes, so that separate tubes may be employed for nebulizing such solutions, as of tannin, chloride of iron, &c., which are likely to form precipitates with other solutions.

The most convenient form of Siegle's apparatus is that figured in the accompanying cut (Fig. 8); the whole in-

FIG. 8.



Siegle's Steam Nebulizer.

closed in a metallic case, which still further lessens the danger of bad results from an explosion. The horizontal tube passes down by an elbow into the boiler through a tightly fitting rubber stopper; and the cork stopper in the opening through which the water is introduced does away with the necessity of any further safety valve. The thermo-barometer is gauged to two atmos-

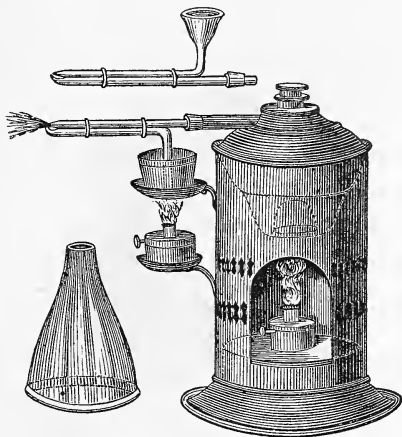
pheres, but the apparatus will be set in action with a pressure of one-half atmosphere. The stronger the pressure the more rapid the escape of steam, and the more rapid the nebulization, and the stronger the propulsion of the spray. The desired pressure can, therefore, be readily maintained by controlling the height of the flame beneath the boiler.

Various modifications of Siegle's Steam Hydrokion have been made by Lewin, Fieber, Beigel, and many others, but they are all on the same principle, and possess no advantage over his.

In all these forms in which the horizontal tube is bent so as to dip down into the boiler, every now and then, especially soon after the apparatus is set in action, the steam condenses at the curve, and as this is driven out by the steam behind, it spurts out hot-water, which is sometimes projected into the face or eyes of the patient with very unpleasant results, and sometimes renders them unwilling to continue the inhalation. This can be in great measure avoided by passing the horizontal tube directly into the boiler at the side close to the top, and thus avoiding the curve where the steam condenses. This is the form of instrument that I am in the habit of employing, with the duck-bill form tubes, which permit of their being introduced within a mouth speculum, and thus avoiding considerable loss of spray. No safety valve is considered necessary, inasmuch as too much steam would force out the cork and thus escape without explosion. With this modification the apparatus, as figured in the following cut (Fig. 9), is essentially the Siegle apparatus, having his original arrangement of a lamp with a screw for raising or lowering the wick. A vaginal speculum introduced well into the mouth pro-

protects the teeth, tongue, roof of the mouth, &c.; and the tubes entering the funnel-end of the speculum, the face

FIG. 9.



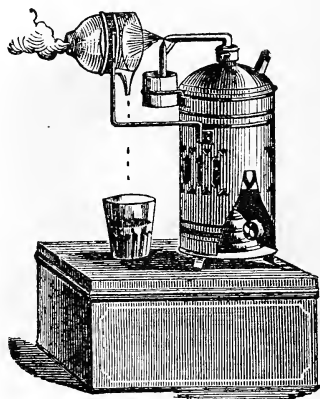
Modified form of Siegle's Steam Nebulizer, with Duck-bill Tubes.

and clothing are thus protected, a very desirable precaution in the inhalation of solutions of the nitrate of silver, &c. The condensed liquid, as it flows over the funnel extremity of the speculum, is directed into an appropriate receptacle, so as to protect the clothing and furniture. The instrument, with all its appurtenances, can be obtained of Mr. GEMRIG, the well-known surgical instrument maker, of this city.

Some of these funnels have a tube below to which a piece of tubing can be attached, and thus act as a waste-pipe to direct the excess. A very convenient combination of this kind with the funnel or face protector attached to the apparatus, has been constructed by Dr. WILLIAM READ, of Boston, which, as seen in

the accompanying figure (Fig. 10), is very compact, and can be readily carried about securely packed in the tin box employed as a stand when the instrument is in use.

FIG. 10.



Dr. BEIGLE, of London, also has constructed a very useful face protector, a sort of concave plate with a central aperture through which the spray passes, placed in front of the mouth of the patient.

Dr. BEIGLE has also devised an admirable little pocket steam apparatus suitable for travellers who desire to continue this method of medication.

LEWIN and some others prefer the horizontal tube to be of metal, with a holder in which slides the glass tube intended to dip into the medicated fluid. This is an improvement, as the risk of breaking the horizontal tube is avoided; and if the glass tube become broken it can be readily replaced by another, and easily adjusted.



## CHAPTER II.

### EXPERIMENTS UPON MEN AND ANIMALS AS TO THE PENE- TRATION OF NEBULIZED FLUIDS INTO THE RESPIRA- TORY PASSAGES.

THE report of SALES-GIRONS to the Academy of Medicine of Paris, as to the results obtained in his inhalatorium, caused a great sensation among the medical profession; and numerous experiments were instituted under different auspices, and with certain predilections in favor of the new method or against it, to determine whether the nebulized fluids really penetrated into the respiratory tract, and if so, to what extent.

At first the number of these investigations was limited because the experiments had to be carried on at the establishments where the method was being employed; but as soon as SALES-GIRONS invented his portable instruments, investigation was further stimulated, and being rendered more convenient of execution, a great number of observers became engaged in the pursuit. The results of these experiments were duly published in the leading French journals, and as the subject spread outside of France, in other European journals. They have been recorded with more or less detail in the works of Waldenburg (*Die Inhalationen der zerstäubten Flüssigkeiten, so wie der Dämpfe*

*und Gase*, &c., von Dr. L. Waldenburg, Berlin, 1864), Fieber (*Die Inhalation Medicamentöser Flüssigkeiten*, &c., von Dr. Friedrich Fieber, Wien, 1865), Lewin (*Die Inhalations-Therapie*, &c., von Dr. Georg Lewin, Berlin, 1865), and others, and alluded to by every one who has written on this subject. As they are interesting and instructive, some account of them will be given here.

*Experiments with Negative Results.*

Prominent among observers reporting negative results, was PROSPER DE PIETRA-SANTA, physician at *Eaux-Bonnes*, whose experiments were performed, partly in the presence of POGGIALE, who had been appointed by the Academy to prepare a report on the subject, in an inhalatorium arranged at *Eaux-Bonnes*, according to the principles of Sales-Girons.

He experimented upon a goat, upon three rabbits, and upon himself and another observer (*L'Union Médicale*, 1861, Nos. 43, 44, and 59; *Gazette Médicale de Paris*, 1861, Nos. 14 and 15).

He caused a young goat to breathe, for a quarter of an hour, an atmosphere loaded with the nebulized mineral water of *Eaux-Bonnes*, to which a small quantity of common salt had been added. The animal was then killed, and a solution of nitrate of silver applied to the larynx and bronchi, but without evincing any reaction.

He caused a rabbit to breathe a nebulized solution of sulphate of iron from the Sales-Girons apparatus, for a period of twenty minutes. The application of a test of cyanide of potassium failed to detect any iron in the lungs or in the larynx; but succeeded in the isthmus of the fauces, on the soft palate, and in one

portion of the œsophagus ; the latter probably because the animal had swallowed some of the fluid.

He held two rabbits within a short distance of the spot where the fluid was nebulized in the inhalatorium of Eaux-Bonnes. The animals were killed, and the test applied with nitrate of silver and with acetate of lead, but without evincing the slightest trace of reaction in the respiratory organs.

M. Prosper de Pietra-Santa read his memoir before the Academy of Medicine, October 8, 1861 (*Gazette Hebdomadaire*, 1861, p. 659), coming among other conclusions, as the result of his clinical observations and experiments, to the following :—that the nebulized mineral waters do not penetrate into the bronchi ; that a considerable depression of temperature is produced at the moment of nebulization ; that a very considerable desulphurization takes place in the nebulization of these mineral waters ; and that the temporary alleviations observed, are due to the inspiration of the disengaged hydro-sulphuric acid gas.

RENE BRIAU, physician at Eaux-Bonnes (*Gazette Hebdomadaire*, 1861, No. 15), at the laboratory of the College of France, placed at his disposition by Prof. Claude Bernard, on 31st January, caused a rabbit to breathe for twenty-two minutes close to the drum of a Sales-Girons apparatus, the nebulized spray of two litres (a litre is 1.0567 quarts) of a solution of cyanide of potassium, the animal remaining tranquil and breathing the whole of the liquid. Immediately after, the animal was killed by section of the spinal cord. The test of a solution of the sesquichloride of iron was applied, and detected the presence of the cyanide salt in the larynx, in the trachea, and in the larger and

smaller bronchi. Prof. Claude Bernard, who, with MM. Vella and Leconte, witnessed this experiment, raised the objection that the substance employed is very readily and very rapidly absorbed into the blood, and that this fact could account for its presence in the respiratory tract; and, at his suggestion, the urine, ureters, and kidneys were also tested, and the same reaction took place. Briau, therefore, did not consider the experiment conclusive. Lewin (*op. cit.*, p. 163), in commenting upon this experiment, very judiciously observes that the absorption into the system might have taken place through the delicate mucous membrane of the respiratory organ.

Then reversing his experiment, Briau caused a rabbit to inhale a solution of the chloride of iron (a salt absorbed with difficulty by the animal tissues) during twenty-six minutes; and the reaction gave again a positive result.

The 6th of February following, a small dog was held close to the drum and breathed tranquilly, for twenty-five minutes, an atmosphere in which two litres of the solution of the perchloride of iron was nebulized. In this case the test could detect no trace of the salt except in the mouth, the nostrils, and the pharynx. He then performed the same experiment with another dog, employing the solution of the cyanide of potassium by inhalation, and the iron salt as the test. Surprised at the different results on two species of animals so closely related, he immediately repeated his experiments upon another rabbit, and on applying the test, in a few minutes the characteristic reaction occurred in the whole extent of the bronchial tree.

Finally, Prof. H. BOULEY (d'Alfort) placed at his

disposal a horse, who had a carcinomatous tumor of the stomach; and on the 18th of February, with the assistance of M. Raoux, he experimented on this animal at the veterinary college. The horse, whose respiratory organs were intact, was placed horizontally with his head on the same plane as the rest of his body. The experiment lasted an hour and a quarter, forty-five minutes being consumed in the inhalation of four litres of a solution of the sesquichloride of iron. After the animal was killed by section of the spinal marrow, the fluid which had been inhaled was detected in the nostrils, but there was no evidence of its having penetrated into the bronchi, the trachea, or the larynx. Briau concludes that he can account for the success with the rabbits on account of the proximity of their glottis to the mouth, and that the fluid in condensing on the posterior walls of the pharynx flows down into the larynx and trachea. In this view he is sustained by Prof. Claude Bernard.

CHAMPOUILLON (*Gazette des Hôpitaux*, 1861, No. 66) directed an invalid to breathe, for half an hour, a solution of the chloride of iron. After the mouth had been thoroughly rinsed, the sputa were tested with cyanide of potassium, but no reaction was produced.

DELORE (*Gazette Médicale de Lyon*, 1861, September 1st and 16th) caused several individuals to inhale nebulized solutions containing iodide of potassium, and tincture of iodine; but found no trace of iodine either in their urine or in their saliva.

ARMAND REY (*L'Union Médicale*, 1861, No. 139) desired to employ an atmosphere more profusely loaded with spray or nebula than could be produced by the apparatus of Sales-Girons, and he constructed an ap-

paratus by means of which the capillary jets of water, projected by a vertical pressure of fifteen metres, were received perpendicularly upon the palettes of a horizontal turbine, very rapidly rotated in the direction opposite to that of the jets. He thus produced a very dense spray, but the whole of the water did not nebulize, a portion of it spurted about unpleasantly. To control this dashing he inclosed the apparatus in a wide-meshed net, but to his astonishment it caught the whole amount of the spray, which it condensed, and did not permit the slightest particle to pass through. Then he employed pasteboard, in which he made openings of the size and form of the human glottis, and again the whole of the spray was caught and condensed.

Then he instituted some experiments upon animals, the results of which were negative.

The cause of these obstructions he attributed to the circumstance that these sprays are merely suspended in the air, and that therefore, as soon as any impediment interfered with their slight impulse, the nebulized particles immediately collected and condensed into drops. Thus the inner surface of the cheeks, the roof of the mouth, palate, &c., being such impediments, they detain the spray, which falls in drops without gaining entrance into the larynx. But, as Lewin observes (p. 177), he seems to have overlooked the fact that in inhalation the inspiratory current as it passes into the lungs will deflect these light particles as they play in the atmosphere, and direct them towards the middle line of the open glottis, so that they will describe a sort of curve in their passage.

EDOUARD FOURNIÉ was the most persistent opponent to the new method, and exercised a remarkable degree

of ingenuity in devising crucial experiments to put to the utmost test the theory that the nebulized medicaments penetrated into the air-passages. (*Proceedings of Académie des Sciences*, 1861; *Gazette Hebdomadaire*, 1861, p. 626; *Gazette des Hôpitaux*, 1862, No. 9.)

At a séance of the Académie des Sciences, held September 16th, 1861, he read extracts from a work of his, entitled, "Mémoire sur la pénétration des corps pulvèrulents, volatils, gazeux, solides et liquides, dans les voies respiratoires au point de vue de l'hygiène et de la thérapeutique," in which he details his various experiments.

In order to test the mechanical feasibility of such penetration, Fournié constructed an artificial respiratory apparatus. He bent at right angles a tube twenty-five centimetres long and two centimetres in diameter, and placed it through one of two openings in a flask, so that it dipped into a solution of sulphate of iron, with which the vessel was half filled. The free extremity of this tube terminated in a wide mouth-piece, which might represent the oral cavity. The other opening communicated, by means of rubber tubing, with the nozzle of an exhausting syringe furnished with a delicate valve which would open as soon as the force exceeded that of the inspiratory force of the lungs of a strong healthy man. He filled a Sales-Girons apparatus with a solution of the cyanide of potassium, and placed it at ten centimetres distance from the mouth-piece of the apparatus; and at the same time that the nebulizer was put in action, the exhausting syringe was placed in action rhythmical with the duration and strength of ordinary human inspiration.

Although the fluid was thoroughly nebulized, the

solution of sulphate of iron did not change color in the least. From this experiment Fournié came to the conclusion that he had demonstrated that the solution of the cyanide of potassium could not be made to enter the flask.

At a later date he instituted a different experiment. Having detached from a recent cadaver, a human larynx with the tongue, epiglottis, and pharynx, he attached to this a glass tube of the diameter of the trachea. Artificial inspiration was produced by placing in the mouth of the experimenter a tube of rubber attached to the lower end of the artificial windpipe; and during the inspiration, the glottis was held open by means of *serres-fines* attached to the posterior crico-arytenoid muscles, while the watery spray from the pulverisateur was directed towards the larynx. It was seen in this experiment that the larger portion of the nebulized fluid struck on the pharynx, and was then and there condensed. Another smaller portion fell down upon the epiglottis, which protected the opening of the glottis like a regular roof, and thence glided in great drops along the aryteno-epiglottic folds to gain entrance into the larynx. Not the slightest trace of the nebulized water could be seen upon the walls of the tube.

This experiment was repeated with solutions sensitive to the most delicate chemical tests, and with similar negative results.

Then Fournié experimented on himself. He took it for granted that if the nebulized fluids penetrated into the trachea and the bronchi, he ought to be able to detect their presence in the sputa expectorated immediately after an inhalation. Suffering at the time from an acute attack of bronchitis, he inhaled a solution of



arsenious acid, five grammes to five hundred grammes of water. He selected this material because it is less readily absorbed through the tissues than others, and at the same time can be detected by reagents when present in the minutest quantity.

He placed himself within five centimetres distance from the opening of the apparatus, and inhaled, to the best of his ability, with widely opened mouth, the entire solution of five hundred grammes. The material expectorated during the few minutes next succeeding, and amounting to four grammes, were dried upon a platinum capsule, incinerated with nitrate of potassa, and the product of combustion placed in contact with water acidulated with sulphuric acid, according to the process of Marsh; but without producing any of the metallic arsenical rings on the porcelain. The reaction ensued, however, as soon as one drop of the arsenical solution was added.

A similar experiment, performed upon a young man laboring under a profuse specific bronchorrhœa, afforded the same negative result.

On another occasion a concentrated solution of nitrate of silver was inhaled through a glass tube of three centimetres diameter, employed in order to protect the mouth from discoloration. Laryngoscopic inspection, immediately after the inhalation, showed the posterior wall of the pharynx tinged with the nitrate, but the interior of the larynx retained its natural color. The sputa expectorated immediately after, showed no evidence of the inhalation.

A young man, twenty-four years of age, who had worn a canula for several years, in consequence of a fracture of the larynx, the result of an accident, was

selected for an experiment. The condition of the young man's organs, as seen by the laryngoscope, was as follows :—Above the vocal cords, everything appeared normal; the cords themselves were colored red, having lost their brilliant mother-of-pearly tint; toward the posterior inferior third of the left vocal cord a small nodule was perceived, having much the appearance of a cartilage. The lesion had not interfered with inspiration, for the arytenoid cartilages separated properly and the laryngeal cavity expanded in the usual manner; but expiration was so difficult that for its performance the tracheal opening was indispensable; the closure of the larynx during expiration seemed to be effected by the lesion in the cricoid cartilage, which had been the seat of fracture, as a result of which the crico-thyroid and posterior-crico-arytenoid muscles had become paralyzed. A bunch of raw cotton attached to a thread was introduced into the trachea, and the pulverisateur set in action. During the inhalation the canula was closed by the finger of the patient, which was slightly raised during expiration; and the solution employed was of iodide of potassium five grammes to five hundred grammes of water. After the inhalation, the cotton was withdrawn and tested with starch and with sulphuric acid, but afforded no reaction.

A similar experiment was performed upon one of the female nurses of the Hospital Beaujon, who also wore a canula in her trachea, and with the same negative result.

From these experiments, Fournié offered the following reasons to account for the non-penetration of the nebulized liquids :—

1st. The divergence of the watery particles in issuing from the apparatus.

2d. The propulsion of the current from the apparatus in a straight line.

3d. The curve of the trachea.

4th. The proximity of the soft palate to the base of the tongue.

5th. The involuntary contraction of the glottis.

6th. The irritability of the larynx.

Finally, he draws the following conclusions:—

1st. It is, nevertheless possible, by this method, to induce a toxic effect upon the larynx, but one of short duration only.

2d. The fluid can certainly penetrate into the air-passages, but not with facility, nor in sufficient quantity; and this only when the inhalation is performed with peculiar care, such as opening the mouth well, separating the base of the tongue from the soft palate, with the head inclined backwards to destroy as much as possible the rectangular curve that the windpipe makes with the oral cavity.

In contradistinction to the difficulty or impossibility of inhaling fluids into the air-passages, he calls attention to the facility with which solid powders can be drawn by inspiration even into the remotest bronchi, in proof of which he cites the various experiments in which he demonstrated that such powders will pass completely through a tube twenty-five centimetres in length and two centimetres in diameter, and bent at a right angle; and he says that while the watery particles condense upon the sides of the tube, solid particles are propelled by successive ricochetting to the very end of the tube.

Fournié believed the sulpho-hydrogen gas, disengaged

from the thermo-sulphurous waters, to be, by its direct contact with the seat of lesion, one of the principal agents in the curation of diseases of the chest.

Lewin (*op. cit.*, p. 174), in commenting upon these experiments, calls attention to the circumstance that Fournié seems to have overlooked the important fact that the trachea and the bronchi, instead of being dry and smooth like the glass tubes used for experiment, are constantly moist, and more or less covered with mucus; and that the pulverulent particles must possess a peculiar strength if they can ricochet over this moist mucus until they reach the bronchi.

If powders penetrate into the bronchi they must be projected in a continuous line, for as soon as they alight on the moist surface they must become entangled and remain there.

As Lewin says, in ignoring as conclusive Fournié's experiment with the excised larynx, in which the epiglottis is placed "like a regular roof over the entrance of the glottis," the epiglottis does not retain this position during deep inspiration, as can be demonstrated by laryngoscopic observation; it becomes more erect. It is absolutely impossible to place the larynx of a cadaver with its pharynx, soft palate, tongue, &c., in the position which they assume during life in deep and voluntary inspiration.

### *Experiments with Positive Results.*

The most extensive series of experiments were performed by DEMARQUAY, surgeon to the *Maison Municipale de Santé*, and these it is, principally, upon which is based the favorable report to the Académie de Médecine (*Gazette Médicale de Paris*, 1861, p. 616).

These experiments were performed at the *Maison Municipale de Santé* in the presence of Profs. Poggiale, Réveil, Gobley, and Trousseau, MM. Mialhe, Sée, Pietra-Santa, Giraud-Teulon, and the students of the institution; and with the assistance of M. LECONTE (*Bulletin de l'Académie*, September 24, 1861; *Gazette Hebdomadaire*, September 27, 1861, p. 627).

Demarquay experimented upon some eighty rabbits, upon a number of dogs, and upon the same female nurse at the Hospital Beaujon, who was made the subject of one of the experiments of Fournié.

The rabbits were caused to breathe an atmosphere loaded with the nebulized spray of a solution containing one gramme of the perchloride of iron to one hundred grammes of distilled water, the apparatus employed being that of Mathieu (and Tirman). The snouts of the rabbits were held forcibly open by a suitable dilator. The experiments continued five minutes, with a few momentary intervals of rest. The animals had all been lively before the experiment; a number of them were killed immediately upon the conclusion of the experiment, and the remainder were saved. Upon testing the respiratory organs of the slaughtered animals with a solution of cyanide of potassium, the presence of iron in a greater or less degree, and in various degrees as respected the individual portions of the apparatus, was demonstrated in the entire respiratory tract, even in the parenchymatous tissue of the lungs; and, upon the addition of acetic acid, the blue tinging became still more apparent. In order that it might not be objected that the fluid ran down the tracts, the experiment was commenced at the bronchial tubes and continued up into the larynx. In some cases the entire bronchial

tree became blue, in others some portions of the minutest bronchi remained uncolored. The chloride of iron was detected in the œsophagus and in the stomach in consequence of the swallowing of some of the fluid. Immediately after the death of the animals, and at intervals during twenty-four or forty-eight hours, sections of lung were placed in contact with a watery solution of cyanide of potassium to which acetic acid had been added, which demonstrated the existence of the iron salt in the very cells of the lung.

The animals which had not been killed were attacked with broncho-pneumonia, and some of them with regular circumscribed pneumonia, within a period of from twelve to twenty-four hours;—a further proof of the penetration of the fluid.

Similar experiments were repeated upon dogs, and with similar results, except that the nebulized fluid was not found in the parenchyma of the lungs.

Upon one of these dogs Demarquay performed the operation of tracheotomy, and then caused it to inhale a solution containing one per cent. of tannin. The wound was tightly closed during the inhalation, which continued several minutes, and at its close he passed into the trachea a piece of paper which had been moistened in a solution of chloride of iron and then dried; and the inky reaction soon appeared.

In these experiments with the dogs, not only were their snouts kept forcibly dilated, but their tongues were drawn forwards by means of threads passed through the organ, to prevent any impediment to the entrance of the fluid by contact of the tongue against the soft palate.

Demarquay experimented upon a female nurse in the

Hospital Beaujon, who was compelled to wear a canula in her trachea. This is the same case upon whom Fournié experimented with negative results. The laryngeal structures were very much contracted, and the patient could bear the withdrawal of the canula only for a brief period at a time. This female inhaled as best she could, a weak solution containing one per cent. of tannin. During the inhalation the tracheal opening was closed by a strip of paper which had been moistened with a solution of the sesquichloride of iron, the paper being confined by adhesive strips, and the whole covered by a napkin. The mouth was placed at a distance of twenty-five centimetres from the distributing tube of a Matthieu's apparatus.

The difficulties in this case were very great from the condition of the glottis, the position of the wound with considerable depression of tissue at that point, and the prominence of the sterno-cleido mastoid muscles. Twice the experiment failed on account of the yielding of the paper and the adhesive plaster, and their partial detachment from the canula; but, on the third attempt, Demarquay kept his finger applied over the opening, and the strip of paper was withdrawn colored black in considerable extent.

Demarquay lays great stress on the result of this experiment as being prominently favorable (*Gazette Hebdomadaire*, 1862, p. 391), for if a larynx so altered from its normal condition, as to be unequal without artificial aid to the admission of sufficient air to sustain life, would permit enough of the fluid to pass it, to be detected by chemical reaction, it is hard to conceive why a larynx in a normal condition would not afford much greater facility of penetration.

At the séance of the Académie de Médecine of Paris, April 29, 1862, Prof. Trousseau exhibited several sections of the lungs of Demarquay's rabbits in which the penetration of the chloride of iron could be demonstrated even to the minutest ramifications of the bronchi.

TAVERNIER (*Expériences sur la pénétration dans les poumons des poussières liquides tenant en dissolution des reactifs cliniques ou des médicaments.*—*Gazette Médicale de Paris*, 1861, p. 808) experimented on himself with a solution of sesquichloride of iron, and cyanide of potassium. He employed the pulverisateur of Sales-Girons and took in long and deep breaths. First, he inhaled the solution of tannin, and then, that of the cyanide of potassium; with each he experienced a sensation of cold in the chest, with some feeling of constriction, and a disposition to cough. After the inhalation, an examination with the laryngoscope revealed that the larynx over and below the vocal cords, and the vocal cords themselves to a greater extent, were covered with a sombre layer, which was nothing else than Prussian blue. Then he rinsed out his mouth again and again until the water contained no more trace of the Prussian blue; and after that he endeavored, by hawking and coughing, to bring up some mucus from the trachea or larynx; this, at first strongly though irregularly colored, was afterwards followed by uniformly colored mucus, which he had not the slightest doubt, had been brought up from the minute bronchi, in contact with the pulmonary cells.

Prof. GRATIOLET, shortly after, repeated Tavernier's experiments upon himself, and reported similar results (*Gazette Hebdomadaire*, 1861, p. 822).

BATAILLE took advantage of a chronic inflammation



of the mucous membrane of the respiratory organs under which he was laboring, and while endeavoring to cure this experimented on himself (*Gazette Hebdomadaire*, 1862, p. 390). He inhaled for a time a solution of the extract of rhatany, and then examined the parts with the laryngoscope. He found the mucous membrane of the larynx and trachea colored red. After a few hours this color had disappeared; nevertheless, during the entire day he expectorated reddish sputa. Bataille concluded that the medicated fluid had penetrated into the bronchi, for his reddish expectorations were of the character designated as "bronchiques."

MOURA-BOUROUILLOU (*Gazette des Hôpitaux*, 1861), experimented on himself, and on patients, with a black fluid. Examination with the laryngoscope discovered the traces of the fluid in the larynx and in the trachea. His experiments upon himself he repeated in the presence of Poggiale. Not only did he demonstrate the presence of the pulverized particles in the trachea, but also their actual entrance and passage through the glottis during inhalation as observed with the laryngoscope (*La Revue Médicale*, December 15, 1861).

AUPHAN experimented to discover how far liquids could be made to penetrate into the respiratory tract. With this view he injected into the trachea of a rabbit four drachms of a solution containing one per cent. of iodide of potassium. No cough was produced. In ten minutes the animal was killed, and he tested the trachea, the bronchi, and the parenchyma of the lungs without producing any reaction with starch. In another experiment he killed the animal immediately after its conclusion, and there ensued a slight reaction. Auphan does not doubt the penetration of fluids into the respi-

ratory tract, which, he thinks, absorbs the material employed very promptly (*Gazette Médicale de Paris*, 1861, p. 315).

SALES-GIRONS performed some experiments with an artificial respiratory apparatus which he constructed out of gutta percha, with a mouth, a soft palate raised up, a tongue depressed so as to expose a portion of the posterior wall of a pharynx which was bent at an obtuse angle, and below it, horizontally, at a distance of three centimetres, was a glottis, and below the larynx, a glass tube represented the trachea. When this apparatus was placed before a pulverisateur and inspiration was drawn through the trachea, the liquid penetrated into that tube; but if the tube was bent into an angle the spray was arrested at the first angle, and fell below in drops of water.

*Report on the foregoing Experiments to the Parisian Academy of Medicine.*

On January 7th, 1862, POGGIALE, as chairman of the committee appointed to investigate this question, made an extensive and very interesting report to the *Académie Impériale de Médecine* of Paris, in which he reviewed the whole subject critically, and in which, in answering affirmatively the question, "Do the pulverized liquids penetrate into the respiratory tract?" he based his conclusions chiefly upon the experiments upon rabbits, made by himself and others, principally Demarquay. He even drew positive conclusions from the experiments reported as evincing negative results; showing that in Briau's cases the fluids were clearly proved to have reached the air-passages, although the animals

had been allowed to breathe through the nose. He referred to the many causes of error in such experiments, arising sometimes on the part of the experimenter himself, who might lack the necessary chemical, physical, or anatomical knowledge necessary for accurate observation; or from want of intelligence or skill of the assistants; or from the nature of the apparatus employed; or, finally, from the manner of managing the animals, their want of co-operation, their struggles, &c., &c. In alluding to the negative result from Fournié's experiment upon the nurse at Beaujon, he showed how the error in that case must have arisen from imperfect closure of the opening of the trachea during the experiment; for Demarquay, in his experiment with the very same individual, had failed twice from such a cause; and not until the third attempt did the experiment succeed. Finally, he believed that the experiments of Fournié himself upon the penetration of powdered substances into the air-passages proved the possibility of the entrance of pulverized fluids.

Four months later, in the discussion before the Academy, held April 29th, DURAND-FARDEL, who had been one of the first to doubt the penetration of these fluids, objected to a portion of Poggiale's views, and for himself came to the following conclusions:—that the fluids penetrated to a considerable extent in the subglottic region and in the trachea, but that such penetration as far as the bronchi had not been proved; for everything went to show that the traces were feebler as the parts were more distant from the glottis; and that, if they did pass beyond the trachea, it was in such small proportion as to deprive them of their therapeutic value

(*Bull. de l'Académie de Med.*, 1862, vol. xxvii, p. 752).

The discussion was continued on May 6th (*idem*), when TROUSSEAU declared himself warmly in favor of the method, expressing some degree of surprise that a doubt as to the penetration of these liquids could be entertained, since the penetration of coal and other materials was a fact beyond dispute; and upon an observation being made by an opponent that the larynx is a vigilant sentinel, denying entrance to foreign bodies, Trousseau replied, "It is a vigilant sentinel, perhaps so, but one that can be taken by surprise. When it cries out, 'Who goes there?' it is already too late;— in other words, when cough occurs, it is because the liquid has already penetrated into the larynx!" As further proof, he exhibited the lungs of a rabbit which had inhaled but five minutes, and in which not only could the penetration of the solution of the iron salt be demonstrated to have reached the parenchyma of the lungs, but further, to have left traces of the existence of a pneumonia excited by means of this inhaled fluid. "Why," said he, "the fluids may penetrate too much, and it is therefore a method of treatment demanding caution."

Poggiale, in reply to Fournié's objections to his report, replied, that the experiments on men and animals leave no doubt as to the penetration of pulverized substances. The experiments of Fournié prove nothing, if compared with the results of those of Moura-Bourouillou. He did not object to Fournié's results with his various artificial contrivances; but contended that, as we have to deal with men and animals, it is with

men and animals that we should experiment, and not with tubes and vessels which have not the elasticity nor pliability of organic tissues. In regard to Durand-Fardel's objection that it had not been demonstrated that the liquids penetrated into the bronchial tubes, he brought forward the cases in which its presence had been detected in the lung tissue; and Demarquay's rabbits, in whom it had produced pulmonary inflammation, for which reasons "the penetration into the bronchial ramifications is an incontestable fact."

Poggiale's report also included the questions as to the change of temperature in the pulverized fluids in issuing from the instrument, the chemical alteration of the sulphuretted waters by the process of nebulization, and the probable value of therapeutical results.

The mineral waters of the various spas do undergo some change, but not so with artificial solutions.

The result of the discussion was an almost unanimous acquiescence with the able report of Poggiale.

### *Further Experiments in Germany and elsewhere.*

The widely disseminated results of the French experimenters, to which reference is made in the preceding pages, soon stimulated similar investigation in other portions of the continent, and we have recorded the researches of various observers in Russia, in Germany, and in Spain.

Dr. FRIEDRICH FIEBER, of Vienna, was the first to introduce the new method into Germany, and with the assistance of his brother, Dr. Carl Fieber, he repeated Demarquay's experiments on rabbits and upon an individual with a tracheal fistule. These experiments

were repeated before Prof. Schroff, and confirmed the results of the French observer.

His experiment upon the individual who had undergone tracheotomy differed somewhat from that of Demarquay upon the nurse at the Beaujon Hospital (*Die Inhalation Medicamentöser Flüssigkeiten*, &c., p. 44). This patient was a shoemaker, aged twenty-two years, of strong frame and healthy lungs, who had been received on September 11th, 1861, in the wards of Herrn Primarius KOLISKO, and who was under treatment for typhus.

October 3d, he was seized with dyspnœa, which, within a few days, increased to such an extent that on the 9th instant he was transferred to the surgical wards, where, on the 11th, the operation of laryngotomy was performed. The patient recovered gradually, but was not able to dispense with the canula.

Some three weeks after the performance of the operation, an attempt was made to withdraw the canula for a few moments, but it had to be promptly returned, and even an experiment made to see how long he could bear a closure of the fistule could not be endured longer than from twenty to thirty seconds.

On the 1st day of January, 1862, Fieber undertook to repeat upon this man the experiment of Demarquay, and the effort was attended with difficulties fully as great as those of his Parisian prototype. In the present instance the difficulty lay less in a contracted glottis, and a strongly projecting sterno-cleido-mastoid, than in the want of intelligence on the part of the patient, who, in addition, was excessively timid, and could not make up his mind to submit to the inhalation until Fieber had

himself inhaled before him. Even then he breathed with so much dread that the first two attempts remained fruitless; but the third attempt, at which he was rather more skilful, gave a positive result, though not to a very satisfactory extent. At the fourth trial, however, the result was more or less similar to that obtained by Demarquay. Fieber employed one of Charrière's apparatus instead of one of Matthieu's, as Demarquay had done, and the solution experimented with contained two per cent. of tannin. He did not place within the opening a piece of paper as a test, but saturated a strip of linen with the solution of the perchloride of iron, and the finger alone was sufficient to close up the opening. Fieber regrets very much that, on account of the many difficulties with which it was attended, he was compelled to forego a laryngoscopic examination at the conclusion of the experiment.

TOBOLD (*Deutsche Klinik*, 1862, p. 211) exhibited at the meeting of the *Berliner Medizinischen Gesellschaft* the lungs of rabbits upon which he had repeated the experiments of Demarquay, and with similar positive results.

SCHNITZLER and STÖRK (*Wiener Medicinalhalle*, 1862, No. 46; *Fieber*, p. 50; and *Wochenblatt der Gesellschaft der Aerzte*, 1862, No. 45; *Lewin*, p. 183) experimented upon the servant of Dr. Störk, with colored solutions, of rhatany, Campeachy-wood, saffron, &c.; and upon laryngoscopic examination, to which the individual was thoroughly accustomed, the coloring could be detected far down the larynx, and in one instance could be followed into the trachea.

These gentlemen also repeated the often-cited experiment of Demarquay, upon an individual who had under-

gone tracheotomy some eighteen months previously, on account of the presence of some syphilitic tumors. The method of experiment was that already detailed in connection with Fieber's case. The first two trials failed, but the third, fourth, and fifth succeeded, the patient inhaling more quietly and deeply, and the strength of the solution being increased from one grain to five to the ounce.

The same experiment was then repeated with a dilute solution of iodine, only the linen was not placed immediately in the tracheal opening, but was fastened to a probe and introduced concealed within a thin tube, so that having been pushed forward and brought in contact with the tracheal mucus, it could be removed again concealed within the tube; the fragment then placed in a strong solution of starch assumed the light blue color. Twice the experiment succeeded; a third time it failed. These gentlemen also repeated Sales-Girons' experiments with an artificial respiratory apparatus, and with confirmatory results. (*Fieber*, p. 50.)

LEWIN (*Die Inhalations-Therapie*, Berlin, 1865, p. 183) contributes five experiments; the first two of which were performed in the presence of Prof. Virchow.

1. A middle-sized dog, bound in a towel, was held by one servant, and while another servant held the snout open, the animal was made to breathe the spray of a solution (1 : 100) of the perchloride of iron from a Mathieu Néphogène, great difficulty being encountered in holding the animal so that the spray could be kept directed into his mouth, for he would forcibly turn his head sideways so as to keep his muzzle out of the line of the current. After the nebulization of twelve ounces of the fluid, the animal, whose eyes had become quite



bloodshot in his efforts to free himself, was killed by section of the spinal cord.

The peculiar black reaction with tannin could be distinguished on the soft palate, the posterior pharyngeal wall, the posterior surface of the epiglottis, and at various spots in the trachea, principally on the lateral walls; but not at all in the bronchi or in the parenchyma of the lungs.

2. A more powerful animal was selected this time, and the following device was pursued to manage more easily the head and snout of the animal, and to secure a more favorable position for the experiment: One side of a chest was so cut out that when closed over the neck of the animal it was completely encircled, the head within the box; in the opposite side of the box the delivery tube of the apparatus was admitted through a suitable opening, and through another small aperture, Lewin watched the effect. The interior of the chest was soon filled with the nebulized spray, but the dog forced his snout downwards to such a degree that the penetrating particles of the fluid were principally received upon his nose and the upper part of his muzzle, and here condensed without at all entering the mouth. The examination, upon killing the animal directly after the experiment, gave a negative result in the larynx and in the trachea.

3. A powerful rabbit was made to inhale six ounces of a solution of chloride of iron (2:100) at a distance of one foot from the apparatus, the muzzle being forcibly dilated. This animal also was very restless, as were all the animals with which Lewin experimented. The tongue was allowed to remain quietly in the mouth, and it was observed to lay with its base so much in

contact with the posterior wall of the pharynx as to occlude the entrance into the larynx.

On examining the slaughtered animal, the fluid employed was chemically detected upon the upper surface of the epiglottis, on the lateral borders of the lower surface, and upon the protrusion at the thyroidal attachment of the epiglottis; but not in the trachea.

4. The same experiment was repeated with another strong rabbit, the nostrils being compressed and the muzzle held open, and with the same result.

5. The same experiment was performed upon a feeble rabbit, which could be so held that the hands did not compress the abdomen and thus impede the respiratory process, as was the case with the other animals.

In this case, the fluid could be detected beyond the bifurcation of the trachea, but not far, and only with slight traces.

In all his examinations upon the cadavers of these animals, Lewin took the precaution to open the bronchi first and proceed towards the larynx, so that no particles of fluid might flow from above downwards.

Lewin, in commenting upon these results, acknowledges that experiments upon animals cannot definitely settle the question of the penetration of these fluids into the respiratory tract. There is a great difference between the voluntary well-directed inhalations of a patient, and the restless, uneasy, unnatural breathing of an animal being experimented upon, to say nothing of the effect of position of the head, tongue, epiglottis, soft palate, &c. He also calls attention to the fact, that the bronchi absorb readily, and that results may take place during life which cannot be demonstrated after death.

Lewin's views are very similar to those of Durand-Fardel.

*Pathological Proofs of Penetration.*

Lewin also details (*op. cit.*, p. 190) a most instructive pathological case, in which, with Dr. Schulz, chemical assistant to Professor Frerichs, he found free iron in the interior of a cavity in the lung of a patient who, shortly before his death, had inhaled a solution of the sesquichloride of iron. This case is as follows:—

A carriage-driver, Müller by name, æt. 48, whose mother had died with tuberculosis, had suffered from dropsy as early as his seventh year, whether ensuing upon an attack of scarlet fever or not, could not be determined. After recovery from this illness, he asserts that he had remained perfectly well until shortly before Christmas, 1861. About this time, during rather a cold spell, he fell asleep upon his box, and on awakening became conscious of a strong drawing pain in the upper thoracic region of the right side. This pain gradually diminished without medical interference, and eventually subsided entirely. Shortly before Easter (April 20th) the patient contracted a fresh cold, attributed to exposure in frosty weather. Since that time he had been expectorating a profusion of sputa, unpleasant to the taste, and producing scraping sensations in the throat.

After some medicinal treatment, the amount of expectoration became moderated during the daytime, so that only after night, and particularly early in the mornings, the patient expelled the sputa, which retained their unpleasant taste and odor, but with less production of the scraping.

The patient sought admittance in the *Charité*, and on May 14th, his *present condition* was noted down as follows:

Patient rather strongly built, with moderately developed but rigid muscles. Color of skin normal; enlarged and congested bloodvessels to be seen upon the cheeks. Mucous membranes moderately congested. Can assume any position in bed, but feels too weak to remain up.

*Throat* well proportioned; its muscles slightly employed in costo-abdominal respiration. A swollen lymphatic gland, rather painful upon pressure, upon the scalenus muscle of the right side. The voice somewhat hoarse. No pain in the larynx.

*Thorax*, in general, well formed, with a slight depression in the region of the seventh rib, right side. The angle of Louis marked, the clavicular furrow deepened, and more so on the right side than on the left. Elevation of thorax tolerably normal, no difference to be detected between the two sides.

*Percussion* produces a tolerably high, lightly tympanic sound at the sixth rib of the right side, in the mammillary line; and so, also, in the right supra-clavicular fossa. Behind, upon both sides, healthy resonance clear beyond the attachment of the twelfth ribs. All over the left side, resonance clear, rather higher over the upper lobe than over the lower one. On the right side, a tolerably intense dull sound, outwards from the eighth spinous process. Stronger fremitus over the whole of the right side than upon the left side, and especially over the region of dullness.

*Auscultation*: left and behind, vesicular murmur with some sonorousness and sibilance; over the entire right side, very loud moist rattling and scanty râles

masking the vesicular murmur. In front, very loud vesicular murmur on the left side, sharp bronchial-like respiration upon the right; expiration rather long; less rattling and whistling than behind.

The patient did not cough very much during the examination. The cough is much greater at night than during the daytime, and is principally induced by change of position. Expectoration easy, with a small quantity of sputum brought up by each paroxysm of cough. There are no long-continued paroxysms of cough with expulsion of large masses of sputum. The sputum is of a grayish-green color, distinctly translucent, only here and there a few mucous shreds extend from its upper mucous stratum, through a watery middle stratum, to its tolerably homogeneous sediment.

*The impulse* of the apex of the heart could not be felt; the systolic heaving was diffuse. Cardiac dulness, normal. Sounds clear, the second sound somewhat flapping at the pulmonary orifice.

The radial artery, somewhat serpentine in its course, of rather strong outline, weak beat, and slight tension.

*Tongue* with a thick gray covering, especially in its central portion.

*Laryngeal mucous membrane* congested, somewhat swollen, and covered with viscid, adherent secretion.

*Abdomen* soft and rather flat; a large scrotal hernia on the right side.

*Spleen and liver* of normal outline.

Appetite rather active; thirst frequent. Alvine evacuations at intervals of two days. Urine cloudy, but without containing albumen.

Temperature 39.5 (C.), pulse 96, respiration 36.

17th. *Morning*. Sleeplessness, moderate sweats, se-

vere paroxysm of cough the night previous. Ordered, *Decoct. cinchonæ* (ʒij) with *Acid. phosphor.*

*Evening.* Temperature 40, pulse 104, respiration, 28.

18th. *Morning.* Temperature 38.5, pulse 96, respiration 40.

Patient prefers to retain the semi-recumbent posture, but without fear of dyspnœa. Thorax rather strongly and actively expanded. Expression of countenance quiet. Quantity of expectoration some eight ounces, slimy, grayish-green in color, and covered with froth in profusion.

19th. *Morning.* Temperature 38, pulse 96, respiration 44.

Yesterday evening, after an attack of dyspnœa, coughed up a good deal of blood, which has afforded considerable relief. The sputa during the day, again about eight ounces, of triple consistence as before; only the fluid middle portion is a brownish-red, instead of a grayish-green. *R̄. Plumb. acet. grs. ij, dos. vj.*

20th. Blood coughed up again, but the quantity cannot be determined. Towards noon deep inspiration produces a stitch in the right side, in the region of the right nipple, and extending up to the axillary region. Percussion sound in the line of the right axilla, appears somewhat shorter than before. Ordered, 10 dry cups over the affected region.

21st. Temperature 38, pulse 128, respiration 44. Has again coughed up blood to the amount of four ounces. The stitch in the side and the dyspnœa have subsided. Ordered, *Plumb. acet. gr. ss., every three hours.*

22d. Temperature 39.4, pulse 120, respiration 44. Again has coughed up about four ounces of blood.

23d. Temperature 38.5, pulse 136, respiration 60. Profuse sweats, great dyspnœa, intensive cough. Strong hæmoptysis to the amount of about ten ounces. Treatment:—INHALATION FROM MATHIEU'S NÉPHOGENE of *Liquor ferri sesquichlorati*, at noon and towards evening, each time thirty drops in six ounces of *aqua destill*. Patient rather short-winded, and so weak that it required great effort to make the inhalation; still after the inhalation he asserted that he felt much more comfortable than he had done before it. He did not cough as much as before by a great deal; the dyspnœa decreased; the amount of expectoration diminished in quantity and less sanguinolent; the patient's countenance fresher and livelier; the speech clearer and stronger than before. Towards evening, temperature 32, pulse 118, respiration 40.

24th. Sleepless throughout the night previous, with severer sweat and cough. Expectoration much more difficult. Although respiration appeared performed in great part by the employment of the accessory muscles, there was no feeling of want of breath. The sputum amounted to three ounces, was translucent, the middle stratum dark brown, without any trace of pure blood discoverable in it. Death at 2 P.M.

*Autopsy*, May 26th.—Marked decrease of subdermoid areolar tissue; the cartilages of the ribs to a considerable extent ossified. On raising up the sternum there was exposed to view, underneath the first rib, a cavity from which flowed out a black fluid with blackish shreds of tissue. Both lungs strongly inflated; the left one totally adherent; the right one less so. From the

bronchus of the left lung there gushed forth a muddy-brown fluid; the lung itself large, loose, pervious throughout, only in the posterior portion strongly oedematous and hyperæmic, moderately strongly pigmented. The bronchi very narrow, even the larger trunks. The muddy liquid distributed pretty fully in the lower lobe. Mucous membrane moderately injected.

Upon the right side the adhesion was produced principally by thick fibrinous masses, under which the pleura appeared strongly injected. THE LOWER PORTION OF THE UPPER LOBE WAS CONVERTED INTO A SAC, WITH THIN WALLS FIRMLY ADHERENT TO THE THORACIC PARIETES, IN WHICH WAS FOUND THE SHREDS AND THE BLACK FLUID ABOVE MENTIONED, BESIDE SOME BLACKISH-RED LUMPS (BLOOD CLOTS). The lower lobe rather adherent. Upon its cut surface were seen numerous prominent grayish-white infiltrations; the remaining tissue was void of air, and on pressure allowed the escape of some of the muddy fluid. The middle lobe and the lower portion of the upper lobe showed broncho-pneumonic infiltration, surrounded by oedematous tissue. The bronchi moderately large, and mostly filled with a brownish muddy-looking fluid. The vessels of the lungs free from adhesions, their inner walls strongly discolored. In the first rib, between the bone and the cartilage, there was a small space which did not appear to have been made artificially. These extremities of the rib appeared a somewhat muddy, gray, partly cartilaginous and partly striated tissue. Outside of it, communicating with the space, lay a small cavity, which was covered with reddish excrescences. The adhesions right at the first rib were rather strong, thick, and, in addition, somewhat slanting.



In the larynx and in the trachea, but little of the muddy fluid. The mucous membrane discolored.

In the heart, much fatty blood. The right cavity rather large in comparison with the left. Valves normal. The pulmonary and aortic valves somewhat glazed. The aorta somewhat dilated above the semilunar valves.

On the border of the anterior sinus of Valsalva of the semilunar valve of the pulmonary artery, and towards the left, was discovered a small opening leading to a bloodvessel, which formed a small sac on the outer side of the aorta, and from which several branches coursed over the aorta; one of the largest of these communicated, by a free vessel at the base of the left ventricle, with a small artery which arose, with a calibre of about a line from the aorta, close to the posterior coronary artery. Close to the opening of the posterior coronary artery there was a still smaller aperture, from out of which air could be forced by blowing into the network of vessels described as originating from the pulmonary artery. At the commencement of the aorta there were a great many adhesions, chiefly rounded superficially.

THE BLACK-COLORED LIQUID FOUND IN THE PROTECTED CAVITY IN THE LOWER PORTION OF THE UPPER LOBE WAS EXAMINED BY THE CHEMICAL ASSISTANT, DR. SCHULZ, IMMEDIATELY AFTER THE AUTOPSY, AND SHOWED THE PRESENCE OF FREE IRON, AS ALSO DID THE BLACKISH CLOTS—OF COURSE BUT IN SMALL PROPORTION. Here we have the strongest possible evidence of the penetration into the lung of inhaled nebulized fluids.

In a somewhat similar case related by Prof. ZDEKAUER, of St. Petersburg (*Wiener Med. Wochenschrift*,

No. 30, 1861; *Fieber, op. cit.*, p. 42; and *Lewin, op. cit.*, p. 240; *et al.*), a patient died from debility shortly after the restraint of a profuse hæmoptysis by inhalations of a strong solution of the chloride of iron. Dr. Holm discovered everywhere in the tissue of the lung iron in greater quantity than could be due to the blood. As Fieber mentions in a foot-note, this case proves the penetration of the fluid into the minutest ramification of the bronchi.

WALDENBURG (*op. cit.*, pp. 111–165) instituted a great number of ingenious experiments upon men and animals, not so much to prove the entrance of the material into the respiratory tract, of which ability he had no doubt, as to determine the quantity or proportion that thus penetrated, and also in what form they reached the parts, whether still as spray or condensed into drops; but, for reasons that are obvious, he was unable to come to any satisfactory conclusion.

Prof. GERHARDT, of Jena (*Inhalation medikamentöser Flüssigkeiten. Ein Beitrag zur Localtherapie respiratorischer Erkrankungen. Von Rudolf Wedemann, Jena, 1862; quoted by Fieber, op. cit.*, p. 49), repeated a number of experiments upon men. He caused several invalids to inhale a chloride of iron solution, and shortly after, by the aid of the laryngoscope, he pencilled the larynx with a solution of tannin. The laryngeal image showed the inky reaction on the apices of the arytenoid cartilages, and on the posterior surface of the epiglottis; in one case, several dark spots could be seen upon the true vocal cords. In one patient, with a fistule between the hyoid bone and the thyroid cartilage, a paper which had been dipped into a solution of tannin was held in the fistule after a few inhalations of

a solution of the chloride of iron had been taken, and the usual reaction of these salts ensued.

WEDEMANN (*op. cit.*, pp. 30-43) records many clinical observations confirmative of the question discussed.

SEMELEDER (*Wochenblatt der Zeitschrift d. k. k. Gesellsch. der Aertzte in Wien*, 1864, No. 1, quoted by *Fieber, op. cit.*, p. 51) found that after the inhalation of astringent solutions, the secretions collected at several places in the larynx as whitish floccules, with a reduction of the capillary injection attendant on inflammation of the true and false vocal cords.

Prof. NIEMEYER, in the latest (6th) edition of his *Manual of Special Pathology and Therapeutics* (1865), states that the fact of the entrance of these sprays admits of no doubt. He had treated with markedly satisfactory results, chronic laryngeal catarrh, follicular laryngitis, and pharyngitis, &c., employing solutions of alum, tannin, and nitrate of silver.

Dr. MORELL MACKENZIE, of London (*Med. Times and Gazette*, 1865, No. 765, p. 213), stated at a meeting of the Royal Medical and Chirurgical Society, of London, Feb. 14th, 1865, that, in conjunction with Dr. Duchesne, of Woodford, he had performed some experiments upon pigs and dogs, and with positive results; and Dr. Gibb expressed his conviction, based upon his own observations, that the fluids penetrated into the minutest bronchi.

Besides the experiments above detailed, many others were instituted by different observers in various parts of Germany, in Russia, Spain, Great Britain, &c., but the results do not differ from those already recorded. The entrance of the nebula, upon voluntary inspiration, into the larynx, can easily be demonstrated by

causing an individual to inhale a colored solution, as of indigo, aniline, &c., under circumstances favorable for penetration, and then examining the parts by aid of the laryngoscope.

In these experiments it is desirable to secure as finely divided a nebula as possible, and its delicacy can be tested by using a colored solution, as of indigo, and allowing the spray to strike against a piece of unglazed paper, which will become more or less completely covered, showing the degree of tenuity of the drops; a plan first employed by Siegle, who binds up in his work a page on which is pasted two strips of paper thus subjected to two apparatuses, his own having produced a spray so fine that the paper looks as if it had been dipped in the solution, so evenly is it colored. Another method of testing the degree of subdivision, and which is applicable to any solution, is to allow the nebula, as it is produced, to strike against a pane of window glass, and notice the minuteness of the condensing particles.

Thus, in despite of the experiments with negative results, we are led to the conclusion that nebulized fluids can be inhaled deeply into the respiratory tract; and that when failure occurs it is due to unfavorable position of the glottis, or an improper method of inhalation.

### CHAPTER III.

THE INHALATION OF NEBULIZED FLUIDS; THE PROPORTION OF NEBULA INHALED; IMMEDIATE EFFECTS OF INHALATION; MANNER OF CONDUCTING INHALATIONS; THE NUMBER, STRENGTH, AND DURATION OF INHALATIONS, ETC.

FROM what has already been narrated it is evident that the inhalation of nebulized fluids can be utilized for the alleviation and cure of disease, and that the method at once enlarges our resources in local treatment; presents us with a means of affecting the system by absorption without compromising the digestive powers of the alimentary canal, or interfering with them; for the mucous membrane of the air-passages is much quicker to absorb than that of the stomach, besides which, the attenuated form in which the remedy is presented secures a subdivision of labor, as it were, on the part of the absorbent vessels, so that an effect more prompt and sustained may be produced, than when the remedy is presented in bulk and thus subjected to gradual ingestion; while the absence of a digestive process secures the absorption of the remedy in the chemical form in which it is exhibited.

It will be seen that the powers of absorption of the pulmonary mucous membrane have been employed for systemic medication, where idiosyncrasy or disease has

prevented the administration of remedies in the usual way.

*How much of the Spray reaches the Larynx, Trachea, and Lungs?*

This is a question that every skeptic puts, and it is a difficult one to answer.

Beigel reports the following results obtained by him with Siegle's apparatus:

"If the boiler, which contains about eight ounces, is half filled, viz., with four ounces of water, and the lamp beneath lighted, the evolution of steam begins in about ten minutes. One ounce of fluid is then, between twenty-five to thirty minutes, turned into spray and inhaled. The quantity of condensed fluid, after the inhalation obtained through the tube of my screen, is about four drachms, the loss in the boiler one ounce. Half an ounce of medicated spray was, therefore, mixed with one ounce of steam. About half of that quantity recoils from the screen into the air, while the other half reaches the mouth. Here, again, about half the quantity remains, to be either swallowed or spit away, *whilst the other half, viz., about three drachms of mixture of steam and medicated fluid passes the glottis and penetrates into the respiratory tract.* In respect to that mixture, the conclusion may fairly be drawn that it contains a far greater quantity of atomized fluid than vapor. Not only because it can be assumed, *à priori*, that the heavier particles of the fluid are driven by the force of the blast into the mouth, whilst the lighter steam mixes very readily with the atmosphere, but because an analysis of the fluid, obtained by condensation, shows that the original strength

of the solution is diminished but little ; at least, it was so in solutions of common salt, which I have tested. The experiment, to show that the steam dissolves into the air, while the atomized clouds rush forth, can easily be made with my screen. The opening through which the patient inhales is closed, the apparatus put into action, and the condensed fluid gathered. If steam merely escapes, we find that after one ounce of water has been turned into steam, about twenty minims only have been condensed and gathered in the vessel, while it contains about six drachms, when atomization has taken place at the same time. *The conclusion is, therefore, obvious, that the strength of the medicated fluid is altered but very little through its mixture with the steam.*" (Beigel, pp. 49, 50, 51.)

The probabilities are, that from one-sixth to one-twelfth of the fluid nebulized reaches the respiratory tract ; but we must allow for the absorption by the buccal mucous membranes of much that reaches the mouth and is there condensed ; and as the proportion differs much according to the manner of inhaling, the doses to be employed will vary according to the proportion apparently actually inhaled in any given case ; in determining which, the physician will have to depend upon his own judgment after witnessing his patient's manner of inhaling.

Dr. JAMES COLLINS, of this city, has furnished me with the following result of some experiments instituted by him to ascertain the probable amount of nebula received into the system.

A steam apparatus was used with the Bergson tubes. The amount of drippings collected were carefully evaporated, and the residue weighed :

<i>Ferro-ferricyanide of potassium</i> , grammes 2,	
were dissolved in 2 ounces of water.	
Residue from drippings, . . . . .	grammes 1.445
Loss, . . . . .	.555
<i>Sulphate of copper</i> , . . . . . grammes 2	
Residue in drippings, . . . . .	1.181
Loss, . . . . .	.819
<i>Bicarbonate of potassa</i> , . . . . . grammes 2	
Residue from drippings, . . . . .	1.545
Loss, . . . . .	.455
<i>Nitrate of potassa</i> , . . . . . grammes 2	
Residue from drippings, . . . . .	1.285
Loss, . . . . .	.715
<i>Muriate of ammonia</i> , . . . . . grammes 2	
Residue in drippings, . . . . .	1.845
Loss, . . . . .	.155

An analysis of the residue of fluid, containing chlorate of potassa 20 grains to the ounce, and deposited on the sides of a mouth speculum which had been used in inhaling, resulted as follows :

On speculum, . . . . .	grammes .058
Residue of 4 ounces of fluid, . . . . .	2.755
Total residue, . . . . .	2.813
Original contents, 80 grains, . . . . .	grammes 5.183
Loss, . . . . .	2.370



*Immediate Effects of the Inhalation of Nebulized Fluids.*

If the nebula really penetrates beyond the glottis, a peculiar sensation will immediately be felt in the trachea and upper sternal part of the chest, according to the depth of the inhalation and the amount of permeation by the fluid. As facility of inhalation is acquired, this feeling will be produced over a greater extent of surface. If the fluid nebulized be at the ordinary temperature, a sense of cold will be felt in the parts; and if ice-water be inhaled the sense of cold will be very distinct. Sometimes a sense of oppression, and occasionally of real soreness, is experienced, especially when at a first attempt at inhalation, a strong solution as of an astringent or caustic is employed; hence it will be found desirable as a rule to cause a patient to inhale some bland fluid at his first attempt until he becomes accustomed to the method, unless it be a case of hæmoptysis, when it is better to proceed at once with the astringent. Hæmoptysis has occasionally been induced by inhalation, having, as will be seen in the following pages, occurred under the observation of Fieber. Dr. Da Costa (*Essay on Inhalation*, p. 20) states that on two occasions he has seen from the inhalation of a strong solution of alum, asthmatic, wheezing breathing very speedily produced, with loud dry râles discernible at various parts of the chest; the attack lasting from eight to ten minutes. Dr. Collins tells me that he has witnessed the same effect.

If discomfort arise during an inhalation, the process should be suspended, and the parts gradually accustomed to the procedure; and if the effect should follow invariably, the method should be discontinued.

Usually, the sensation is not disagreeable; the first few inhalations induce titillation of the glottis provocative of cough; but this soon ceases, and at subsequent inhalations cough is not produced; and, indeed, in some instances, the inhalation does not produce any cough. As a general rule, there is cough at the conclusion of each inhalation, or shortly after it, with freedom and increased facility of expectoration.

If there is inflammation of the upper air-passages with pain and soreness, the inhalation almost invariably affords an immediate feeling of relief, probably by supplying moisture to the parts, and of course as a topical effect also of the narcotic or sedative which may be employed.

### *Manner of Conducting the Inhalation of Nebulized Fluids.*

The patient should sit at ease in front of the apparatus, the distributing tube from which should be on a level with his mouth. Siegle recommends that the patient lean the chest forward with the elbows or arms resting upon the edge of a table. This position will, I think, be found the most suitable and convenient, unless in exceptional cases. Waldenburg recommends that the patients should, when strong enough, stand up and take their inhalations; but this position does not permit of as free an expansion of the chest, and calls off part of the muscular force of the auxiliary muscles of respiration for the maintenance of the erect posture, and, necessitating frequent respiration, the inspirations are, of course, less deep. Lewin prefers that the back should be supported, instead of permitting the patients to lean forward.

As soon as the apparatus is in action, which, with the steam apparatus, will usually be in from three to five minutes after the application of the flame,—and sooner if the precaution be taken to pour hot water into the boiler, thereby saving time and alcohol,—the patient should be directed to incline his head a little backwards, thus bringing the oral and laryngeal cavities more towards a direct line, and the spray, with or without the intervention of a funnel or face protector, allowed to pass into the mouth of the patient, who should make deep and regular inspirations and expirations.

It is impossible to give precise rules as to the distance from the apparatus at which the patient's mouth should be maintained, or the time that shall be occupied in each inhalation. Differences suitable to each case, dependent on irritability of structures, facility of inhalation, &c., will occur with every individual. Usually a rather warm spray is more pleasantly endured at a first inhalation, and therefore it is well at the beginning of each inhalation to place the delivery tube at a distance of but from four to six inches from the mouth of the patient, and then gradually increase the distance to from twelve to twenty-four inches, as may be most suitable. If the laryngeal structures are very irritable, the first sitting should not occupy more than five minutes, and the inhalation should not be repeated the same day. As the parts become accustomed to the irritation, and the facility of inhalation increases, the time of each inhalation may be increased to ten or fifteen minutes, and be repeated from two to ten times a day, according to the indications.

It will be found a better plan to designate a certain quantity to be inhaled as a dose, and gradually increase

the amount, than to prescribe a certain number of inhalatory efforts, or a certain duration of time; as regard to either of these particulars distracts the attention of the patient.

The temperature of the spray lessens with the increase of its distance from the apparatus, and the force of the current is also affected in like manner but in a less degree, this depending rather upon the rapidity with which the steam is formed and heat regulated by controlling the size of the flame with the screw attached to the wick.

The following are the rules laid down by Siegle to be observed with his apparatus, having the thermo-barometer to designate the steam pressure.

1. { Stream strong.                      Temperature high.  
     { Thermo-barometer 2°.          Distance 2-6 inches.  
         *e. g.*, In Laryngitis Crouposa.
2. { Stream strong.                      Temperature low.  
     { Thermo-barometer 2°.          Distance 1-2 feet.  
         *e. g.*, In Pharyngitis Chronica.
3. { Stream weak.                        Temperature high.  
     { Thermo-barometer 1°.          Distance 2-6 inches.  
         *e. g.*, In Tuberculosis of Lungs and Larynx.
4. { Stream weak.                        Temperature low.  
     { Thermo-barometer 1°.          Distance 1-2 feet.  
         *e. g.*, In Hæmoptysis.

In the apparatus of Sales-Girons and others working by pressure, the temperature can be increased by placing a flame behind the drum; the current of the nebula creates a vacuum directly behind the point on which the spray strikes, and this draws the flame inwards and heats the spray.

It is difficult to lay down special rules which shall be

applicable to every case, and every physician employing this method will soon learn by practice to regulate the manner of inhalation so as to suit his cases. Practice soon enables the patients to inhale properly, and also to overcome the disposition to cough, which is sometimes very great in their earlier efforts. Where difficulty is anticipated, or where patients manifest considerable concern, it will be best at first that they should merely be allowed to inhale the steam issuing from the apparatus, or plain water, and then the medicated fluid can be added gradually. For the same reason the pressure of the steam at the commencement of a sitting may be moderated, gradually rising to a higher degree of the thermo-barometer by increasing the size of the flame.

Where the patients are more intelligent, but at the same time nervous, a somewhat similar management may become necessary. Such patients can sit at first a little sideways, so that the current streams past the face; then, as they become accustomed to it, they can bend forward from time to time so as to get the open mouth in the passing current, and then take in a deep breath of the spray from the side.

With small children and bed-ridden patients, the apparatus can very readily be so placed that the current can be directed into the mouth of the patient while lying upon his side. The pillows and adjacent bed coverings must be covered with some suitable material before the inhalation is begun, in order to protect the bed from moisture.

Larger children are most conveniently managed by taking them upon the lap in order to remove their anxiety, and showing them the movements of inhala-

tion. In this manner children of three years of age soon learn to inhale with real enjoyment or childish delight in the process.

Moura-Bourrouillou recommends holding the nostrils closed by means of the finger or some special contrivance, in order the better to secure penetration of the spray into the air-passages. Traube recommends that the patient should extend the tongue well out of the mouth. Siegle holds both of these directions unnecessary; on the contrary, if the tongue is very fleshy and seems to be much in the way, lessening the oral orifice, he directs the patient to keep it depressed himself with a knee-shaped spatula. The mouth speculum subserves the purpose of a tongue-depressor.

The physician must by no means neglect to watch the first inhalations of his patient; otherwise, after a few moments, the tongue will be allowed to raise so that its base will press back upon the soft palate instead of being flatly applied to the floor of the mouth, with the tip behind the lower incisor teeth; or the head will have assumed an unfavorable position, the mouth be no longer properly opened, the inspirations become less energetic, or too frequent, &c. &c.

Siegle also recommends that, in the beginning, the patient take an inspiration as if he were going to gape, or inspire after a quiet prolonged articulation of the diphthong sound *æ*.

At the close of the inhalation, the patient should cleanse the mouth and pharynx by gargling with fresh water. If, however, the inhalation has been taken for an affection of the mouth or pharynx, this gargling can be dispensed with, that the medication may secure a longer local effect.

In concluding, Siegle cannot call too much the attention of physician and patient to the following rules :

1st. Take care that the temperature of the spray and the strength of its propulsion remain constant during the entire continuance of the sitting. This has reference to the patient's distance from the instrument, as well as the pressure as indicated by the thermobarometer.

2d. Never permit an inhalation to be taken after bodily exercise or mental excitement, so long as the temperature of the skin remains elevated, or the pulse or respiration disturbed.

3d. Several hours must elapse between a hearty meal and the inhalation.

4th. In affections of the pharynx the respiratory efforts of the patient need not exceed those of his ordinary breathing. In affections of the larynx, the wind-pipe, the bronchi, and the lungs, the force of the inspiration must be greater in proportion to the distance of the affected structures from the mouth ; the deepest inspirations being necessary in affections of the lungs.

5th. Let the patient rest awhile from time to time during the inhalation ; and under no circumstances must the length of a sitting exceed a period not justified by the strength of the patient.

6th. The excess of spray condensing in the mouth and accumulating, especially when not composed of harmless substances, such as mere water, common salt, &c., must be expectorated into some conveniently placed receptacle.

7th. Children and infants should not be out of view for a single moment during the inhalation.

8th. After the inhalation let the patient, who will

then begin to cough more than usual, remain quiet for a quarter of an hour before he leaves the apartment.

9th. During the inhalation the patient should not be allowed to speak, nor should any conversation be held with him. His entire attention should be directed upon the inhalation.

Before proceeding with a medicinal solution it is often well, especially with nervous patients, to begin with pure water, and gradually add the medicated solution drop by drop. In some cases, where even water could not be inhaled, Beigel has found advantage from employing milk, after the inhalation of which for some time, he has been able to proceed with the desired remedy.

With some children Hawk succeeded by forming his solution into an emulsion, so that it was mistaken for milk, and thus inhaled more readily than if the subterfuge had not been resorted to.

#### *Number, Strength, and Duration of Inhalations, &c.*

The time which shall be devoted to taking an inhalation will depend upon the quantity of the medicament which is desired to be introduced at each sitting, and upon the special apparatus employed, the minuteness of the particles of the spray, and considerations of a similar character. The glass apparatus of Lewin has been so constructed as to nebulize two ounces of fluid in one minute by from forty-eight to fifty-two strokes of the pump; and as he has found the most convenient quantity for each inhalation to be forty-eight ounces, it will require twenty-four minutes to reduce this amount into spray. This will be found rather a tire-



some sitting for most patients, and also very wasteful of the fluid, for his own experiments show that of the forty-eight ounces nebulized, but three ounces find entrance into the mouth of the patient; and therefore the strength of the solution must be so graduated as to contain in three ounces as much of the substance dissolved as is desired to be brought in contact with the mucous membrane of the pharynx, larynx, bronchi, &c.

With the apparatus of Bergson, eight ounces are required to be nebulized to introduce three ounces of spray into the mouth, which will take from twelve to fourteen minutes, and require about forty-eight compressions of the bellows or bag. With Mathieu's néphogène six ounces are required, consuming from ten to twelve minutes. With Lewin's steam hydrokomion, four ounces, and twenty minutes. It is difficult to say how much of this goes beyond the larynx or into it. With most of the steam apparatuses it takes from ten to fifteen minutes to nebulize an ounce—the usual amount employed for one inhalation; but by increasing the force of the steam, and enlarging the size of the capillary openings of the tube, it can be accomplished in from four to seven minutes.

For acute diseases, usually three and four inhalations daily will be sufficient. More frequent inhalation will be requisite in croup and diphtheria. In chronic affections one or two a day will suffice.

## CHAPTER IV.

### ARTICLES OF THE MATERIA MEDICA SUITABLE FOR NEBULIZATION.

ANY article of the *materia medica* soluble in water or in weak alcohol, is suitable for submission to the method of nebulization. Oils, and solutions in glycerine, have also been employed; but a fine spray cannot be produced with them, inasmuch as the aperture from which the fluid escapes must be larger than for watery and spirituous solutions; though for applications anterior to the larynx they are much better adapted than ordinary pencillings or garglings, because, by the minute subdivision of particles, more complete contact is secured, as well as a more continuous effect.

The sulphurous waters are decomposed by this process, giving off their hydrosulphuric acid; but the extemporaneous solutions usually employed are not thus altered.

The materials employed should be chemically pure, and the solutions well filtered before using, in order that no sediment may accumulate to clog up the aperture through which the fine stream of fluid is forced.

Simple pharmacy is more necessary to be observed here, than in the administration of remedies by the stomach; and it is best always to begin with as weak a solution as will suit the case, the substance employed

to be selected with reference to a physiological and therapeutical influence upon the constitution, as well as for its local effect.

The absorptive power of the mucous membrane of the respiratory organs being much greater than that of the stomach, poisonous substances must be employed with great caution, and the doses be augmented very gradually.

The strength of any solution to be employed will depend upon the individuality of the patient, his distance from the instrument, the length of the sitting, and similar considerations.

*List of Medicines hitherto Nebulized for Inhalation;  
with the Doses, &c.*

The following list comprises, to the best of the writer's knowledge, all the principal remedies hitherto used for purposes of inhalation by the process of nebulization, with the doses in which they have been employed, the diseases for which they are recommended, and, as far as could be ascertained, the authorities by whom they were first introduced :

1. WATER.

*a. COLD WATER.*—First recommended by Fieber in hæmoptysis, at a temperature of 8°–10° R.

A very grateful application to the burning heat of certain pharyngeal affections.

*b. WARM WATER.*—Extensively employed to promote secretion, to dilute mucus and facilitate its detachment from the mucous membrane of the air-passages. Valuable in laryngeal angina and laryngeal croup (*Siegle*). Applicable to local relief in diphtheria. A grateful application in all forms of inflammation of the pharyngeal and laryngeal and tracheal mucous membranes. Promotes expectoration in croup by supplying watery material and retarding evaporation in the formation of false membrane. Useful to

relieve the pain of ulcerative processes and keep the parts cleansed. Used in asthma and bronchitis.

## 2. POTASSÆ PERMANGANAS.

Used by *Reveil* (*Arch. Gén. de Med.*) as a disinfectant to purify the atmosphere, nebulizing in the room a solution containing one large teaspoonful to two and three-quarters pounds of water. Also 20–30 drops per day in pharyngeal diphtheria.

I have found it valuable as a detergent and astringent in ulcerative tonsillitis and other suppurative affections of the throat.

## 3. LIQUOR FERRI SESQUICHLORATIS.

*Dose:* 5–30 drops to the ounce of distilled water. In much stronger solution as a styptic in chronic pharyngitis and chronic laryngitis.

*Diseases.*—In hæmoptysis (*Hillairet, Zdekauer, Lingen, Lewin, Waldenburg, Siegle, Wedemann, Leiblinger, Fieber, &c.*); to repel excessive secretions from the air-passages; in pulmonary catarrh; in atonic affections of the respiratory organs. In whooping-cough (*Siegle*). In the earlier stages of phthisis, and as a weak inhalation in hysterical aphonia (*Da Costa*). In diphtheria (*Lewin*).

According to *Lewin*, contraindicated in phthisis of delicate females, accompanied with fever and irritability of the mucous membrane.

Care must be taken that the teeth are not blackened by this solution, and it is therefore desirable to pass a mouth speculum some distance beyond the teeth to protect them.

Unless prepared at the moment required, the solution should be kept in a dark place, to prevent precipitation of the salt.

Accumulations of sediment upon the glass tubes are best removed by baths of sulphuric acid.

## 4. FERRI SUBSULPHAS (*Monse's Salt*).

*Dose:* Grs.  $\frac{1}{2}$ –10 to the ounce of water.

*Diseases.*—Same as other salts of iron.

## 5. ALUMEN.

*Dose:* 5–30 grains to the ounce of water, or some aromatic infusion.

*Diseases.*—Inflammation, especially catarrhal, of the pharynx and upper air-passages. Excessive secretion (*Niemeyer*). In

hæmoptysis (*Tobold, Polansky, Schlesinger, Siegle*), where it seems to produce a more prolonged effect than the chloride of iron. Diphtheritis (*Lewin*). Laryngeal excrescences (*Siegle*). In combination with tar-water in phthisis (*Waldenburg*).

In a coarse spray, an excellent substitute for the gargle in inflammatory conditions of fauces, tonsils, &c. With the duck-bill tubes, and Clarke's bellows, it can be accurately applied.

In acute tonsillitis, and acute inflammations of the adjacent structures generally.

#### 6. ACIDUM TANNICUM.

*Dose*: 1–20 grains to the ounce of water.

*Diseases*.—The same as alum; but seems more applicable than alum where the affections have attained some chronicity. Diphtheria, pulmonary gangrene (*Trousseau*). Croup of the larynx (*Barthez, Lewin, Fieber*). Œdema of the glottis (*Trousseau*). Chronic catarrhs; chronic affections of fauces, pharynx, larynx, &c. Hypersecretion. Hæmoptysis: ℥j—ʒss. to Aq. fl. fʒj (*Polansky, Fieber*). Polypoid excrescences (*Fieber, Siegle*). Paralysis of vocal muscles (*Klimbacher*). As an antiseptic.

Begin ordinarily with small doses, and desist if it produce too much dryness or sensation of heat.

#### 7. EXTRACTUM RHATANIÆ.

Employed by *Bataille* in chronic inflammation of the mucous membranes of the air-passages.

#### 8. ARGENTI NITRAS.

*Dose*:  $\frac{1}{2}$ –10 grains to the ounce of water.

*Diseases*.—Granular pharyngitis (*Lewin, Waldeman*). Inflammations and ulcerations of pharynx and larynx. Moist growths. Diphtheritis (*Lewin*). Chronic laryngeal and pharyngeal catarrhs (*Niemeyer*).

Care must be taken that too deep inspirations are not taken when employed for affections of the upper passages.

The mouth speculum, a face protector, or a mask, should be used to prevent discoloration of the face.

The solution should be kept in the dark, and refiltered before being used.

#### 9. ALUMINIUM NITRICUM.

*Dose*: Grains 2–5 to the ounce of water.

First used by *Beigel*, who prepares it from a simple solution of the metal in nitric acid; agitating the crystals in distilled water repeatedly, condensing the solution by evaporation, and recrystallizing. Rendered great service, not only in inflammation, but also in nervous affections of the larynx and trachea.

#### 10. SODII CHLORIDUM.

*Dose*: Grains 1–drachms 4, to the ounce of water.

Useful in catarrhs of the air-passages.

*Waldenburg* uses it in doses of 1–10 grains to the ounce, and attributes to it all the good effects produced by the inhalation of the various mineral waters.

*Beigel* sets the apparatus in different parts of the room so as to get up a sort of artificial sea air in the atmosphere for a time; and he recommends it as giving great relief in all stages of consumption.

*Lewin* employs it in small doses to relieve cough and promote expectoration.

*Liebig* recommends it in combination with tannin in chronic catarrhs with difficult expectoration.

#### 11. LIQUOR SODÆ CHLORINATÆ.

*Dose*: f℥ss–f℥j.

*Diseases*.—In bronchitis with offensive and copious expectoration. In phthisis. As a disinfectant to purify the atmosphere.

#### 12. POTASSÆ CHLORAS.

*Dose*: Grains i–xx to the ounce of water.

*Diseases*.—Diphtheria (*Fieber*, *Lewin*). Aphthæ of children (*Siegle*). Pharyngitis (*Lewin*).

#### 13. POTASSII IODIDUM.

*Dose*: Grains ij–xx to the ounce of water.

*Diseases*.—Granular inflammations of larynx and pharynx. Induration and chronic thickenings of laryngeal structures (*Lewin*). In glandular complications. Chronic bronchitis with emphysema.

#### 14. POTASSII BROMIDUM.

*Dose*: Grain i–x to the ounce of water.

*Diseases*.—Laryngeal croup (*Schnitzler*).

## 15. TINCTURA IODINII.

*Dose:* Gtt. j-xx to the ounce of water.

*Diseases.*—Follicular inflammations of larynx and pharynx. Pharyngitis sicca. All affections of the throat where there has been implication of the glandular structures. Granular pharyngitis (*Siegle*).

## 16. AMMONIÆ MURIAS.

*Dose:* Grains ij-3ij to the ounce of water.

*Diseases.*—Recent laryngeal and bronchial catarrh, where it promotes expectoration (*Lewin*). Emphysema; catarrh; simple bronchitis (*Gerhardt*, of Jena). In combination with salt, in phthisis (*Gerhardt*, of Jena). Pneumonia, croup, chronic bronchitis, chronic pneumonia. In early forming stage of bronchitis.

## 17. POTASSÆ CARBONAS.

*Dose:* Grains x-3ij to the ounce of water.

*Diseases.*—Same as muriate of ammonia, especially in certain forms of follicular pharyngitis (*Siegle*). Follicular pharyngeal catarrh (*Lewin*). Substitute for a gargle; also, for a very dilute solution of caustic potassa. Pseudo-membranous croup; whooping cough; pneumonia.

## 18. PLUMBI ACETAS.

*Dose:* Grains iij-x to the ounce of water.

*Diseases.*—In obstinate, troublesome colds, not yielding to other medicament (*Beigel*). Also, by *Waldenburg*. In acute catarrhs of larynx and bronchi (*Fieber*).

## 19. ZINCI SULPHAS.

*Dose:* Grains v-xx to the ounce of water.

*Diseases.*—As a gargle in chronic inflammations. In excessive secretions (*Siegle*, *Fieber*, *Lieblinger*).

## 20. CUPRI SULPHAS.

*Dose:* Grains j-xx to the ounce of water.

*Diseases.*—Chronic inflammations. Pharyngitis and laryngitis (*Vogler*). Ulcerative tonsillitis. Ulcerations of fauces and pharynx. Pulmonary gangrene (*Trousseau*).

## 21. LIQUOR POTASSÆ ARSENITIS.

*Dose:* Gtt. j-xx to the ounce of water.

*Diseases.*—Nervous asthma (*Trousseau, Wistinghausen, Lewin*)

## 22. SODÆ CHLORAS.

*Disease.*—Asthma.

## 23. LIQUOR, IODINII COMPOSITUS.

*Dose:* Gtt. ij-xv.

*Disease.*—Chronic bronchitis (*Da Costa*).

Pot. iod. ℥j-ʒss.; iodinii pur. grs. j-ij; aqu. dest. ℔ij. In syphilitic laryngitis (*Waldenburg*).

## 24. ARGENTUM IODIDUM.

Used by *Gibb* in phthisis in the second stage with profuse expectoration, and with laryngeal affections at the same time.

## 25. HYDRARGYRI BICHLORIDUM.

*Dose:* Gr. ss.-ij to the ounce of water.

*Diseases.*—Syphilitic affections of pharynx and larynx (*Lewin, Schnitzler, Waldenburg, Demarquay, &c.*). In syphilitic excrescences (*Siegle*). The inspirations must not be too deep.

## 26. AQUA PICIS LIQUIDÆ.

*Dose:* fʒj-ij of officinal solution.

*Diseases.*—Putrid bronchorrhœa without fever (*Lewin, Waldenburg*). Colliquative sweats, and purulent secretion of phthisis (*Lewin*). Pulmonary gangrene. Dilated bronchi with emphysema (*Waldenburg*). Vesicular emphysema.

*Siegle* calls it an antiseptic, par excellence.

## 27. AQUA CALCIS.

*Dose:* 1 part lime to 100 of water.

*Diseases.*—Diphtheria; pseudo-membranous croup (*Biermer*).

## 28. AQUA ASSAFETIDÆ.

Used, by *Lewin*, in asthma with emphysema, in combination with aq. menth. pip. and aq. castorei.



## 29. AQUA AMYGDALARÆ AMARÆ.

A good menstruum for chloride of iron and other irritant articles (*Lewin*). A sedative in painful affections of the larynx and upper air-passages. Excessive paroxysmal cough (*Siegle*).

## 30. TINCTURA OPII SIMPLEX.

*Dose*: Gtt. v-xx to the ounce of water.

*Diseases*.—Suitable to troublesome coughs in any affection where opium is not contraindicated. Suitable to painful inflammations, as in angina tonsillaris, &c. As an addition to other solutions.

## 31. EXTRACTUM OPII.

*Dose*: Gr. j-v to the ounce of water.

In this largest dose I have used it to avert a severe tonsillitis, producing all the physiological effects of the drug much more promptly than by ordinary administration.

In doses of gr.  $\frac{1}{4}$  to gr.  $\frac{1}{2}$ , Dr. Da Costa uses it in irritative coughs, and as an adjunct to allay irritation.

## 32. MORPHIÆ ACETAS.

*Dose*:  $\frac{1}{12}$ — $\frac{1}{8}$  gr. to the ounce of water.

*Diseases*.—Same as preparations of opium.

## 33. EXTRACTUM HYOSCYAMI ALCOHOLICUM.

*Dose*: Gr.  $\frac{1}{4}$ -2 to the ounce of water; of fluid extract, gtt. iii-x.

*Diseases*.—Spasmodic coughs. Whooping cough, intense bronchitis, bronchial catarrh with spasm (*Fieber*). Phthisis (*Leiblinger*, *Lewin*).

## 34. EXTRACTUM CANNABIS INDICUM.

*Dose*: Gr.  $\frac{1}{4}$ -1 to the ounce of water.

*Diseases*.—Spasmodic cough of phthisis (*Leiblinger*).

## 35. TINCTURA CANNABIS INDICA.

*Dose*: Gtt. v-x to the ounce of water.

*Diseases*.—Spasmodic coughs. Irritative coughs.

## 36. EXTRACTUM CONII.

*Dose*: Gr. j-vj to ounce of water; of fluid extract gtt. iij-vij.

In very painful irritations in larynx (*Lewin*); in hyperæsthe-

sia of larynx (*Waldenburg*). In irritative coughs. In asthma (*Da Costa*).

### 37. TINCT. BELLADONNÆ.

In nightly irritative coughs of children (*Sales-Girons, Blache*).

### 38. ATROPIÆ SULPHAS.

*Dose*:  $\frac{1}{2}$  gr. to 20 ounces of water.

According to Fieber, unnecessary and dangerous.

### 39. TINCT. STRAMONII.

*Diseases*.—Asthma. Same as other narcotics (*Lewin*).

### 40. TINCT. DIGITALIS.

*Diseases*.—Same as other sedatives (*Lewin*).

### 41. TINCT. LOBELIÆ INFLATA.

*Diseases*.—Asthma. Same diseases as other sedatives (*Lewin*).

### 42. TINCT. OPII CAMPHORATA.

*Diseases*.—Irritable coughs; as a sedative in painful affections of upper air-passages.

### 43. GLYCERINA.

*Diseases*.—In inflammation of bronchi. In pertussis (*Fieber*). In dry cough of phthisis (*Leiblinger*).

With tannin (1 pt. tannin, 50 parts glycerine, 100 parts water) to soothe irritation from inflammation of the pharynx, particularly if applied in the first stage (*Demarquay*). Its antiseptic qualities destroy the fetid odor frequently exhaled by patients laboring under certain diseases of the pharynx and palate.

In laryngitis and tracheitis, associated with hoarseness and loss of voice (*Scott Alison*).

### 44. OLEUM TEREBINTHINÆ RECTIF.

*Dose*: Gtt. j-ij to ounce of warm water.

In the chronic catarrh of emphysema (*Leiblinger*). Chronic bronchitis with offensive secretions. Bronchorrhœa. Gangrene of lungs.

## 45. OLEUM CADINUM.

*Dose:* Gtt. j-ij to ounce of warm water.

Chronic catarrh of emphysema (*Leiblinger*).

## 46. OL. CUBEBS.

In the same affections as the oil of turpentine (*Trousseau*).

## 47. OL. COPAIBA.

In the same affections as the oil of turpentine (*Trousseau*).

## 48. OLEUM OLIVÆ.

In an oleaginous mixture with gum arabic in dry cough, in bronchitis, and in whooping cough (*Fieber, Leiblinger*).

## 49. OLEUM MORRHUÆ.

This has been used in phthisis, &c. Makes the room smell too unpleasantly to be much used in private practice.

## 50. OLEUM PINI.

This has been used in alcohol by Lewin as excitant in aphonia, but without material result.

## 51. CAMPHORA.

With mucilage of gum Arabic in the putrid expectoration of phthisis (*Fieber*); but must be discontinued on the appearance of congestion or irritation.

## 52. QUINIE SULPHAS.

*Dose:*  $\frac{1}{4}$ -2 to the ounce of water.

Used by Fieber in a regularly returning paroxysmal cough in a consumptive female. Quin. sulph., grs. ij; tr. opii, gtt. vij; alumenis, grs. v; aq. font. f $\frac{3}{4}$ j. On the same day in which it was given hæmoptysis ensued, but whether the result of pulmonary congestion due to the quinia is uncertain.

Used in intermittent fever by Ancelon (*La Rev. Médicale*, t. 4, pp. 598-601).

Used in intermittent fever by Sales-Girons (*Gazette Médicale*, Sept. 8th, 1866). In tuberculosis (*Sales-Girons*).

## 53. ACIDUM CARBOLICUM.

*Dose:* Gtt. iii-x to ounce of water.

In all stages of phthisis (*Wolfe, Lange*).

## 54. MINERAL WATERS

At Wistinghausen. In laryngitis and pharyngitis with viscid secretion and troublesome expectoration. First stage of phthisis (*Auphan*).

*Sulphurous Waters:* In hoarseness. Granular pharyngitis. Angina tonsillaris. Granular laryngitis and pharyngitis. Aphonia. Spasm of the glottis. Bronchial catarrh. Asthma. Phthisis (*Sales-Girons*).

Spengler thinks these mineral waters restore the functions of the ciliary epithelium.

## CHAPTER V.

### DISEASES TO THE TREATMENT OF WHICH INHALATIONS OF NEBULIZED SOLUTIONS ARE APPLICABLE.

SALES-GIRONS considers inhalations in this form indicated in acute and chronic diseases of the pharynx, larynx, trachea, bronchi, and lungs; in nasal catarrh, in asthma, in tuberculosis; also in acute tonsillitis, pharyngitis, bronchitis, pneumonia, simple and pseudo-membranous angina, and croup. At first he employed the method in chronic affections only, and the earlier remedies resorted to were the sulphurous waters of Eaux-Bonnes, Pierrefonds, de Labassère, &c.; and inasmuch as the treatment was pursued at these various watering-places, the plan was that the patients should drink one glass of the mineral water every morning upon the empty stomach, and afterwards inhale a certain quantity broken up into spray by the pulverisateur.

Subsequently he added to his *materia medica* tar water, salt and water, and solutions containing iodine and chlorine, and finally he added the emollients, sedatives, and antiseptics, the chloride of iron in cases of hæmoptysis, and quinine as antiseptic in the last stages of tuberculosis. The duration of the inhalation depended on the condition of the patient, the stage of the disease, and the nature of the remedy. In chronic affections of the respiratory organs, where sulphurous

waters, tar-water, and emollient remedies were employed, the sitting continued some twenty minutes,—the time ordinarily consumed in nebulizing a glass of the mineral water. The inhalations were given twice a day, the first one in the morning before meals, and the second towards evening. When deemed advisable, and well borne by the patient, a third inhalation was permitted in the afternoon.

BRIAU (*Gazette Hebdomadaire*, 1861, No. xv, p. 229) gives the results arrived at by himself in 49 cases, in all of which he employed the apparatus of Sales-Girons, the patient being seated in close proximity to the spray as it left the point of nebulization, and breathing it in slowly and deeply. In no instance was cough or other irritation induced. Some of the cases experienced a sense of tickling referred to the region of the base of the epiglottis. With the exception of one young lady who felt unwell for a few minutes without assignable cause, they all bore the inhalations well.

All other treatment was abandoned for the time, save drinking the mineral waters of the resort.

Of the 49 cases there were

28 of simple or granular pharyngitis.

2 of syphilitic plaques, with pulmonary tuberculosis.

2 of simple ulceration of the larynx.

2 of nervous aphonia.

6 of chronic bronchitis.

4 of pulmonary tuberculosis with pharyngitis.

2 of uncomplicated pulmonary tuberculosis.

3 of hæmoptysis without discoverable pulmonary lesion.

Positive results were observed only in the two syphilitic cases, but without amelioration of their pulmonary

symptoms. Both patients had drunk the mineral waters for fourteen days without the slightest beneficial effect upon the local affection ; but after the fifth inhalation the inflammation began to diminish, and soon subsided entirely. One of the cases, however, was at the same time under the use of the protiodide of mercury.

In the other cases of pharyngeal and laryngeal disease, Briau acknowledges no other effect than that which could be attributed to an ordinary gargle, the better for being a running water gargle, and of very long duration.

He noticed no effect whatever in the cases of pulmonary disease which he could attribute to the new method.

The majority of the patients took one inhalation daily of from fifteen to forty-five minutes' duration. Three of the cases of laryngeal disease took two inhalations daily. One of these was a case of ulceration from impaction in the left ventricle of a husk of corn, minute portions of which were coughed out at intervals. This patient had fifty-three séances in one month. Another was a case of functional aphonia, in which forty-two séances were tried ; and the third was hoarseness from a non-specific ulcer on one of the true vocal cords.

These patients were made to inhale with the head inclined forwards, although the observer admits that the spray might have had better access to the larynx had their heads been inclined backwards.

In valuing these observations of Briau it is to be remembered that he was opposed to the method. (See page 41.)

*Coryza.*

By closing the mouth and giving the head the proper inclination, the nebulized spray can be readily inspired into the nostrils.

Waldenburg reports favorable results with solutions of common salt, and of muriate of ammonia, in that form of coryza known as the dry snuffles.

The profuse secretion of coryza can be diminished by inhalations of alum, which, by its antiseptic properties, will destroy fœtor when present.

*Acute Inflammation of the Fauces and Pharynx.*

Local applications by means of gargles have long been employed in these affections; but independent of the pain which frequently follows attempts to gargle under such circumstances, it is impossible to gargle in such a manner that the fluid shall come in contact with the posterior pharyngeal wall, without a voluntary attempt to swallow, which produces but imperfect contact. One can prove this by gargling with any colored solution, such as indigo or aniline, and then examining the parts before a mirror. He will find the roof of the mouth, tongue, and soft palate covered with the color employed, while the deeper parts of the throat are not discolored.

Hence, in the expressive language of Dr. Da Costa, "for really valuable purposes the day of the gargle has passed," for by means of this new method we can direct the spray to any desired point, and secure its contact without any other co-operation on the part of the patient than that of simply opening his mouth to permit ingress.



The articles principally employed in these affections are tannin and alum. I prefer the latter in acute inflammations generally, independent of its less unpleasant taste. The solution may be of the strength of from five to twenty grains to the ounce of water, and the inhalations should be frequently renewed, say an ounce of such a solution should be nebulized five or six times a day, and the patient inhale as much of it as possible. Better effects usually follow at a low temperature, but the solution can be warmed if desirable. If there is a great deal of pain the extract of opium, grs.  $\frac{1}{4}$  to gr. j, can be advantageously added to the solution; and indeed, in some cases, an opiate inhalation of itself will be of great value.

In a severe case of angina tonsillaris in a lady of this city who is subject to ulcerative attacks of tonsillitis, and several members of whose family I was attending during the epidemic of influenza of last year, I succeeded in aborting the disease by strong inhalations of opium, employing a solution of five grains of the watery extract to the ounce of distilled water, and repeating half the quantity at intervals of two hours. The relief to the pain, difficulty of breathing, &c., was very prompt, narcotism soon ensued, and after a sound sleep deglutition was again practicable, and inhalations of warm water simply were substituted for the opiate inhalations, of which she had taken but three, containing ten grains of the extract of opium; but it must be remembered in connection, that the patient was in bed, took the inhalations from the side, and the probability is that not more than three grains at the utmost gained access to the parts, some of it being diffused in the air,

and a good deal that entered the mouth being driven out again in expiration.

In the milder cases of acute angina, inhalations of lukewarm water, or milk and water, will often suffice.

In inhalations for diseases of the pharynx the inspirations should be very light, and for those of the fauces hardly any inspiratory effort is necessary, the natural movement of inspiration being sufficient.

Prof. Seitz has seen the best results in angina tonsillaris from nebulized ice-water (*Fieber, op. cit.*, p. 106).

I have frequently been able to reduce recent inflammation of the tonsils very promptly, in those subject to tonsillitis, by the inhalation of a solution of alum, five to ten grains to the ounce, repeated every hour or two hours until the desired effect had been produced. I have also succeeded with solutions of sulphate of copper three or four times daily. Of course, if a purge was necessary, it was directed to be taken.

In these inflammatory cases I like to direct the spray by means of properly curved nebulizers.

### *Chronic Inflammations of the Fauces and Pharynx.*

For these affections as ordinarily met with, I rather prefer the effects of a solution of tannin in the proportion of gr. j—x to the ounce of distilled water. It is better to make the solution as it is required, to prevent change into gallic acid, and to filter the solution before using it. In my own hands, tannin has given better satisfaction than alum, though by many they are used indifferently. I think tannin produces a more chronic effect than alum, and this is what is desired. Here the inhalations need not exceed two a day, for the disease

will require more or less time for removal, and hence the superiority of the effect of tannin.

In very obstinate cases, with alteration, thickening of the mucous membrane, I have seen good results from morning and evening inhalations of a weak solution of the sulphate of zinc, a grain or two, to two, three, or four ounces of distilled water. In obstinate cases, which have resisted these measures, I have sometimes employed a solution of iodine with advantage. In the dry variety of the disease, *pharyngitis sicca*, I can testify to good results from a solution of muriate of ammonia; though in one instance, of long standing, in a baker, where the sal-ammoniac failed, daily inhalations of a solution of iodine, ten drops of the tincture to the ounce of water, morning and evening, accomplished the result; and the man was able to resume his employment after having been compelled to abandon it for more than two years.

I have seen several cases of *pharyngitis sicca* in shopkeepers, which have been promptly relieved by inhalations of sal-ammoniac. In these cases, I have advised the inhalations to be taken at the place of business, and three times a day,—before opening the store, at noon, and before closing.

Wherever there has been ulceration, I have employed local applications of nitrate of silver or other protective to the ulcerated spots, for such applications are much more effectual than the spray.

I have met with one or two cases of chronic inflammation of the fauces and pharynx in stokers, exposed for several hours at a time to a hot fire; and have found the inhalation of the spray of warm water, or warmed infusion of wild cherry bark, answer an admirable pur-

pose in relieving the dryness of throat and frequent disposition to cough, to which they were subject.

I have, however, had one case under treatment for many months, of chronic pharyngitis with a relaxed state of the mucous membrane of several years' standing, in a brick mason, which has resisted all the treatment detailed, as well as the employment in the same manner of the bromides of potassium and ammonium separately and together, alone and in combination with iodide of potassium, and almost the entire range of sedatives and alteratives; with and without systemic treatment. Temporary amelioration has occasionally followed the employment of a new remedy; but the greatest advantage has been experienced during the healing of a blister on the outside of the neck produced by the inunction of Croton oil.

It will be often found desirable to ring the changes on various astringent and alterant applications, as the parts become accustomed to their influence one after the other.

Inhalations of a weak solution of the nitrate of silver have been employed with success in cases of obstinate chronic pharyngitis. I have had no experience with the article in that form for this affection, except when an accompaniment of laryngeal phthisis.

### *Hypertrophied Tonsils.*

Inhalations of tannin, tincture of the chloride of iron, &c., come in play very well after excision of these glands, as astringents and as hæmostatics to arrest profuse hemorrhage after the operation.

*Syphilitic Angina.*

This affection has been treated with good effects by Briau, Demarquay, Schnitzler, Waldenburg, and Lewin, by inhalations of a solution of corrosive sublimate, one or two grains to the ounce of distilled water.

*Granular Pharyngitis.*

Demarquay found great benefit in a dozen of cases from the inhalation of tannin, 1 part to 100 of water, with the use of the waters of Eaux-Bonnes, where the treatment was instituted.

In general, the condition of the patients improved under the influence of three to four nebulizations a day. Sometimes improvement began in a single day. In from twenty to twenty-five days, he cured a young lawyer, whose voice lost its power on moderate exercise, of a dryness of the throat, with slight but long-continued cough and bloody sputa. Examination of the pharynx showed a chronic inflammation of the entire region, with a normal development of the pharyngeal glands. Trousseau witnessed this case.

Demarquay, however, does not consider this treatment a radical cure for granular pharyngitis, the cause of which he considers to exist deeper in the organism.

*Pharyngo-Laryngitis.*

Dr. Johann Schnitzler reports (*Wiener Medicinal-Halle*, 1862, No. 48, p. 442) one case in an individual about 30 years of age. Marked improvement ensued in a few days from inhalations of tannin, five grains to the ounce of water. This was not considered a curable

case, inasmuch as the patient would not give up the abuse of spirituous drinks, to which his catarrh was partly attributable. (*Lewin, op. cit.*, p. 259.)

I have repeatedly verified the experience of Schnitzler, Waldeman, Fieber, Lewin, and others, as to the effect of astringent inhalations in these affections; and, occasionally, the result has been so prompt as to stagger credence; and the like of which, certainly, has not attended other treatment. A couple of cases from my note-book in illustration:

C. F. H——n, a stout, hearty driver of an express wagon, contracted an intense laryngitis and pharyngitis from exposure incident to his employment. When he was sent to me, April 6th, 1866, after the disease had existed three or four days, his voice was very hoarse, and he complained of great pain in swallowing. Laryngoscopy revealed intense congestion of the laryngeal mucous membrane, including that covering the vocal cords. He inhaled a nebulized solution of alum during fifteen minutes with great relief, and the following day the pain and dysphagia had left him, the voice was almost natural, and the parts had assumed their normal appearance.

Mrs. E—— S——n, came to me on Saturday night, April 14th, 1866. Two nights previously, this lady had taken cold. There was great oppression of breathing, and on examination I found her to be suffering from general faucitis, submucous laryngitis, with submucous infiltration of the aryteno-epiglottic folds.

I projected some spray of ether upon the fauces; and shortly after caused her to inhale from the steam-nebulizer, one ounce of a saturated solution of chlorate of potassa. The following morning she returned;

there was still a little hoarseness, but the other symptoms were gone, so that, to all intents and purposes, she was well. I applied within the larynx a douche of sulphate of zinc, 15 grs. to fʒj, to stimulate the mucous membrane; and after that the patient did not return.

Mrs. F——n, of this city, applied to me May 1, 1866, recommended by the express driver, whose case has been mentioned. She had been suffering from sore throat for several days. I found infiltration of the aryteno-epiglottic folds and of the mucous membrane covering the cartilages of Santorini. Inhalations of alum water were administered, and she was directed to take three comp. cath. pills at bedtime. The next day she returned much the better for her purge and her inhalation. The inhalation of alum was repeated in the evening, and the day following she was sufficiently well to resume her domestic employments and dispense with professional services.

I might mention in this place an unusual case of faucitis which occurred in a young lady of this city under my care, in which the disease was confined to one side, cut off short at the mesial line, so much so that the uvula presented a forked-like appearance, and indeed was mistaken by me for a bifid uvula on account of the inflammation and swelling on that side, and dragging the other side down without implicating it in the inflammation. During the treatment, I showed this case to several professional gentlemen, to whom it was as novel as to myself. Nitrate of silver gr. xx ad fʒj, was projected on the parts from a Bergson's apparatus, and in ten days the parts began to heal rapidly, the

general health improved, and the emaciated patient regained her embonpoint.

### *Follicular Pharyngo-Laryngitis.*

In this form of sore throat, to which clergymen and other public speakers are subject, I have found great benefit from the continued use of inhalations of tannin in weak solution. Sometimes it will be necessary to make a change in the remedy, and employ some other astringent for a time, and then resort again to tannin. Good results have followed the inhalation of a weak solution of opium or hyoscyamus, at a somewhat elevated temperature, just before employment of the voice. I have found this advice of value to lawyers and public performers subject to this and kindred affections. The permanent cure of this affection necessitates the withdrawal for a time from exposure to the causes which produced the trouble in the first instance. I cannot affirm that I know of a single case in which a permanent cure has been effected, though I have treated several; all of whom report greater relief from the inhalations than from any previous treatment, and resort to their apparatus as they find they have occasion for it.

### *Acute Laryngeal Catarrh.*

SIEGLE reports (*op. cit.* 52) that he employed in many cases inhalations of tannin and alum, but not with much benefit, unless he dieted the patients and kept them abed. When the severer symptoms had diminished, and the main object was to lessen the difficult expectoration, he found the greatest advantage from a solution of sal ammoniac, 4 grs. to the ounce of distilled water,



several times daily, in close proximity to the apparatus.

Waldenburg found the best result from a solution of common salt, 4 to 10 grs. to the ounce of water.

Fieber reports prompt success from sulphate of zinc with the addition of laudanum. The inhalation of alum water, to which a little narcotic may be added, will usually induce a great deal of comfort. Inhalations of warm water often afford a feeling of relief.

Biegel reports several cases cured by inhalation of solutions of alum.

### *Chronic Laryngitis.*

Dr. JOHANN SCHNITZLER (*Wiener Medicin. Halle*, 1862, No. 48) reports five cases. Three were treated with inhalations of alum, two with tannin; rapid and marked improvement in all. Improved appearances noted with the laryngoscope; the mucous membrane appeared paler shortly after each inhalation than before. In one case of chronic hoarseness, before inhalation, the vocal cords were covered with accumulations of mucus, and after inhalation they were cleaned off, and the voice had become clearer likewise.

Tannin, the salts of iron, and chlorate of potassa, are the remedies most frequently recommended for inhalation in this form of disease, and may be adequate to a cure when there is no constitutional implication.

### *Laryngeal Phthisis.*

DEMARQUAY reports great improvement from an inhalation of tannin, 1 part to 100 of water, in a case of laryngeal phthisis, in which deglutition was very painful and almost impossible.

In one case of laryngeal phthisis which terminated

fatally under my own care, as indeed have all the cases which I have attended to their termination, great temporary relief followed for a long time inhalations of nitrate of silver, a grain to the ounce of distilled water.

For the dysphagia so constant an attendant upon these cases, I have found considerable relief from inhalations containing opium or some other narcotic.

In some cases, where violent fits of coughing follow almost every attempt to swallow, I have seen relief from inhalations of this kind, ringing the changes upon the astringent and narcotic preparations, as the system became less influenced by the article under employment.

In one case of laryngeal phthisis, in a glass grinder, under the care of Dr. William H. Pancoast, of this city, which I had the opportunity of observing frequently, considerable temporary benefit accrued from the inhalation at different times of astringents, narcotics, and of lime water. This case also, terminated fatally.

Lewin has recommended in these affections, the inhalation of a nebulized solution of nitrate of silver, gr. 1-2 to the ounce of distilled water. I have once or twice resorted to them, but the beneficial effect did not compare to that of local medication by the probang, with a strong solution of the salt.

*Inhalations of Solutions of Nitrate of Silver in Chronic Diseases of the Air-Passages.*

Dr. LUDWIG JOSEPH, of Breslau, reports (*Deutsche Klinik*, May 26th, 1866) that he has employed inhalations of nebulized fluids in chronic affections of the larynx, bronchi, and lungs, the medicament principally

used being solutions of nitrate of silver of various strengths. With Tobold he has experienced more benefit from them in affections of the bronchi and of the lungs, than in affections of the larynx, where topical treatment can be better carried out, and with more benefit. The effect of the nebulized fluids in laryngeal complaints is too weak, and not sufficiently energetic. Their mild influence is more applicable to affections of the bronchial tubes, and of the air-cells, where powerful effects are not required.

In chronic bronchial catarrh, with profuse secretion from the bronchial mucous membrane, and in bronchiectasie, he found the inhalation of nitrate of silver of incontestable value. He found it lessen the abnormal secretion from the mucous membrane, stimulate the membrane by its slight irritation, and thus gradually assist the resumption of its normal functions. It seems also to tone up the bronchial mucous membrane. The effect is not equal in all constitutions, but is best in slow, sleepy, torpid, scrofulous individuals. It is well borne in well-founded cases of suspected tuberculosis. Dr. Joseph has treated several cases of frank tuberculosis, demonstrable by physical exploration, in this manner, with the result of diminishing the amount of ulcerative processes, and promoting general improvement. In these cases the general condition of the patients was favorable.

Among others, the following case of chronic bronchial catarrh, with suspicion of tubercle, is of great interest:

P—— K——, of Bremen, æt. 29, a merchant, small in build, of delicate frame, well nurtured, came under treatment September, 1864, having failed to obtain re-

lief from his disease, from various remedies that had been judiciously employed. He was made to inhale a solution of nitrate of silver, five grains to the ounce of water; and within three weeks the expectoration ceased entirely, and at the date of writing, twenty months after, there was not a trace of cough or of expectoration.

Dr. Joseph has never seen any direct injury from the inhalations of these solutions of nitrate of silver. At the first sittings, the patients feel an irritation along the course of the trachea, continued sometimes as far as the xiphoid process of the sternum,—a feeling of rawness. Immediately after the inhalation, a quantity of thick tenacious secretion is often expectorated with ease.

He reports a case of bronchiectasie (dilatation of the minuter bronchi) in which the most remarkable improvement followed the inhalation, for six weeks, of solutions of nitrate of silver, gradually increased in strength to a scruple of the salt to the ounce of distilled water.

He has used, with good results, in painful affections, a solution of the acetate of morphia in bitter almond and fennel-seed water, as recommended by Fieber and others.

### *Croup.*

Dr. JOHANN SCHNITZLER (*op. cit.*) reports two cases of *croup*, treated with inhalations of a solution of *bromide of potassium*; one of which terminated fatally, the other resulting favorably.

*1st case.* This was a three-year-old boy, a sister of whom had recently died of croup. The Doctor saw the child on the third day of the disease. It was then

lying in a state of apathy upon its mother's arms, the countenance pale, the eyelids half closed, the hands hanging by the side. Suddenly the child became uneasy, put its hands up to its throat, and began to cry and to cough, but both cough and voice were toneless; the child could be seen to cry and to cough, but it could hardly be heard to do so. The breathing was difficult, and marked by the peculiar râles of croup; the pulse was small, barely to be counted, and gliding from under the finger. Examining the fauces, large white patches (*plaques*) covered the tonsils and the entire posterior pharyngeal wall. During the examination, the breathing became more difficult, and the child hurriedly but vainly gasped for air. An emetic had no effect. In spite of the unfavorable prognosis, an attempt was made to save the patient, and an inhalation of a solution of bromide of potassium, five grains to the ounce, was instituted. As a large proportion of the fluid struck the pharynx, it detached much of the patches, which was spat out. For two hours the child felt better, but soon the threatening symptoms recurred again, and in spite of five repetitions of the inhalation, the child died that night with symptoms of suffocation.

*2d case.* This was a well-developed child, six months old, with pseudo-membranous croup. Inhalations of bromide of potassium, ten grains to the ounce of water, were administered. After fifty to sixty inspirations, instead of the râles, a flapping respiration ensued, as from the air passing and repassing a membrane partially detached. Soon there was so much improvement, that the cough was less frequent and the voice less hoarse. This improvement continued four or five hours, when the previous symptoms returned. Another inhala-

tion produced the same relief, which continued throughout the entire night. The following morning, the child's appearance was quieter, the pulse had gone down from 130 in the minute to 100, and voice and cough were somewhat hoarser, but the cough no longer so severe. Another inhalation produced again the same effect as before, but to a greater extent; another inhalation was given in the evening; followed by quieter sleep. Pulse in the morning 96-100; two inhalations during the day. The next morning, the fourth of the treatment, after the child had in all taken six inhalations, two ounces each time, the breathing had become quiet, pulse not accelerated, voice nearly as clear as natural, and the cough almost entirely gone.

Prof. BIERMER, of Berne, relates (*Schweizerische Zeitung für Heilkunde*, 1864, p. 157, *Lewin, op. cit.* p. 287; *et al.*) the following interesting case of *laryngeal croup* in the adult, cured by *inhalations of warm watery vapor and of lime-water*.

A young girl of eighteen years of age, was treated in the beginning of March, 1864, for what appeared to be a simple laryngitis. During breakfast on the morning of March 13th, there suddenly ensued an intense paroxysm of cough, with appearance of asphyxia, cyanosis, cool extremities, loss of consciousness, and complete insensibility. The physician who was called in the emergency, recognized the necessity of immediate resort to some powerful restorative, and applied a hot hammer upon the breast; but without exciting any reaction. Under continued severe irritation of the skin, and the use of liq. ammon. anisati, the patient gradually came to, and eventually coughed up a considerable quantity of croup membrane; after which the

respiration became easier. After this attack, the breathing remained stenotic, rattling, and whistling. On her reception into the hospital, the morning of the same day, the countenance was still very livid, the eyes dull, the pulse very feeble and small, the nose and extremities cool, and the crowing respiration accompanied by paroxysms of cough, during which, pseudo-membrane was expectorated. One patch was ring-shaped, having received the impression from one of the rings of the trachea. External irritation, and calomel, succeeded in diminishing the dyspnœa. The next morning, intense dyspnœa again set in, accompanied with the ordinary croupal long-drawn inspiration, with the employment of all the auxiliary muscles, and marked inspiratory incurvation of the scrobiculus cordis. In spite of the vomiting induced by an emetic, the orthopnoetic symptoms increased, with lividity of the countenance and great distress, during the continuance of the cough. Under these circumstances, in order to moisten the dry mucous membrane of the air-passages, the inhalation of warm water, broken up by the pulverisateur, was employed. This agreed with the patient so well, that finally boiling water was permitted to be nebulized through the apparatus, for the patient declared that the warmest steam possible afforded her the greatest relief. She inhaled the warm steam for an hour with great eagerness, and expectorated to a considerable extent, while the dryness and difficulty of breathing gradually lessened. Then a stormy suffocative paroxysm of cough came on, during which a considerable quantity of mucus and pieces of croupal membrane were expelled. The patient then breathed much more freely, and felt greatly relieved. From this time

on, she inhaled every two hours warm lime-water, in the proportion of one part to thirty, each inhalation continuing a quarter of an hour. From this time forward, the symptoms of croup declined more and more, and with a profuse expectoration of thick, crumby, yellow, purulent masses; the fever abated, and convalescence began the following day; the aphonia, however, continuing until the 9th of April, when it also began to disappear.

M. Biermer, and all those who watched the progress of this case, were convinced (*Brit. & For. Med.-Chir. Review*, July, 1865, from *Bul. Gén. de Therap.*, April 15, 1865) that the inhalations had a solvent effect upon the false membrane; but the Professor does not recommend an exclusive adoption of this local treatment, which softens and detaches the exudations, but does not reach the cause of the disease, which must be combated by constitutional remedies, calomel being considered the chief.

Prof. Biermer was aware of the case of croup reported by Siegle, as cured by inhalation of nebulized water, very warm, and he attributes the happy result chiefly to the high temperature, especially when lime-water is added to it.

Prof. Biermer was led to the employment of lime-water from the statement of M. KÜCHENMEISTER, of Dresden, that diphtheritic membranes are rapidly dissolved in lime-water. This was confirmed by Förster, of Dresden, and also by Prof. Biermer, who repeated Küchenmeister's experiments before the students of his clinical lectures in the University of Berne, placing some pseudo-membranous exudations in a small glass of lime-water; and they disappeared before the eyes



of the students in from ten to fifteen minutes, leaving only a slight sediment in the bottom of the glass.

Dr. BRAUSER, of Ratisbon, has also lately published (quoted in *Brit. & For. Med.-Chir. Rev.*, July, 1865) a case of croup in a child of four and a half years old, treated in the same manner, a perfect cure. M. Brauser insists on the necessity of using the inhalations hot.

SIEGLE (*op. cit.*, p. 60) reports a very severe case of membranous croup with impending death, in a child two years of age, for whom he had tried all the usual remedies in vain. He was about instituting inhalations of nitrate of silver or tannin, when the rapidly threatening symptoms of want of air seemed to him to be less due to obstruction by croupal membrane, than to ineffectual attempts to detach the accumulating mucus; to assist these, he administered inhalations of warm steam, and very soon the patient began to spit out portions of the membrane. After an inhalation of a quarter of an hour, the child breathed more freely, and after twenty-four hours, during which it was more or less kept up day and night, the child bringing up a good deal of mucus, and shreds of croup membrane, which the mother removed from its mouth with her finger, the life of the little patient was saved.

Siegle also reports another case of croup in a little boy of five years of age, in which several inhalations of tannin were taken daily by the little patient, who quietly submitted to the new method; but in spite of the amendment of some of the most desperate symptoms, the patient died.

BARTHEZ (*Traitement des ang. diphth. par la pulv.*, Paris, 1861, *Lewin, op. cit.* p. 224-235) details four

cases of croup, treated by him at the Hôpital des Enfants, St. Eugénie, with inhalations of tannin, 5-10 parts to 100 parts of water, from eight to twenty times a day, fifteen to twenty minutes at a time; in which he observed the excellent effect of the remedy upon the membranous exudation. Respiration became freer, the dyspnoea diminished, and the suffocative paroxysms disappeared. Two of the cases terminated fatally, in consequence of the systemic poisoning, for in one of the cases where the presence of the membrane had been diagnosed, no trace of it could be found upon post-mortem examination.

*The first case*, a girl æt.  $4\frac{1}{2}$ , was one of general diphtheritis, with pseudo-membranous exudation in the nostrils, upon the lips, in the mouth, larynx, and doubtless in the bronchi. Death occurred on the sixth day after commencing treatment, and the twelfth of the disease. At the autopsy there was no relic of pseudo-membrane anywhere on the tonsils, pharynx, larynx, trachea, or bronchi.

This case showed us, remarks Barthez :

1st. A modification of the local appearances after 24 hours, under the influence of the nebulized solution of tannin.

2d. The local improvement the greater, the more the pseudo-membrane came in contact with the nebula.

3d. The corresponding diminution of the general symptoms of diphtheritic intoxication, with the diminution of the local symptoms.

*The second case*, a boy æt.  $5\frac{1}{2}$ , was diphtheritis of the pharynx, larynx, and nostrils. Internal treatment with large doses of sesquichloride of iron, and inhalations of a tannin solution; immediate and permanent benefit by

the inhalation of tannin; improvement in the croupal symptoms while the systemic poisoning rapidly increased, and the child died on the twelfth day of the disease, and tenth of the treatment.

*The third case*, a boy æt. 3, was one of *angina membranacea*—croup in the second stage. Treatment by inhalation began on the fourth day, with repeated inhalations of a nebulized solution of tannin. For three days the disease remained stationary; then improvement rapidly ensued, with recovery on the ninth day.

*The fourth case*, a girl æt.  $3\frac{1}{2}$ , was one of croup in the first stage, with pseudo-membranous exudation upon the tonsils, the soft palate, and the uvula. Prompt recovery on the fourth day of treatment by inhalation of a solution of tannin.

FIEBER (*op. cit.*, p. 114), who, having translated Barthez' cases, treated fifteen cases of his own in the same manner, reports two-thirds of them cured, the remaining third having terminated fatally. He combats Barthez opinion as to the mechanical effect of the tannin, which, according to that observer, is to pucker the membrane, so that its edges roll over, and it thus becomes gradually detached; and states that he has never seen this effect, but that the membrane appears to him to become, as it were, dissolved under the influence of the tannin.

Dr. DA COSTA (*Essay on Inhalations*, New York, 1867, p. 30) in commenting upon these cases, remarks that when we look at the length of the treatment, it does not look as if the remedy had any marked solvent power, for diphtheritic membranes are not permanent structures, but are very apt to disappear from the circumference to the centre within a week after their appearance; and hence, if we accord any value to the treatment—

which, bearing in mind the usually fatal character of laryngeal diphtheria and the grave character of pseudo-membranous croup, we cannot totally refuse to do—we must also admit that the action is not rapid, and not what we might expect from a solvent; nor can we overlook the effect of the water in the combination as a cleansing agent, and as tending to aid in removing and in expectorating the breaking-down textures, for in Siegle's hands the inhalation of pulverized warm water alone produced the greatest relief in an apparently hopeless case.

My own experience with inhalation in croup is limited to a single severe case of catarrhal croup, in which the relief of very distressing symptoms repeatedly followed inhalation of lime-water.

Dr. JAMES COLLINS, of this city, furnished me with the following record of his experience with inhalations in croup:

*Pseudo-membranous Croup.*—Mary E——, æt. 11 months. Was called to the case November 18, 1866. Patient apparently beyond recovery. Lime inhalations employed with little or no effect, and the patient died.

A. B——, æt. 3 years. A robust, healthy child. Had been unwell for a few days, suffering from cough, neglecting its play, and becoming somewhat peevish; but had shown no alarming symptoms until the previous night, when the cough became more brazen and spasmodic. I found the child with marked fever, dyspnœa, husky voice, distressing and spasmodic cough. On examination I found the fauces lined with an albuminous deposit. Lime-water inhalations were at once instituted, and a mustard bath, while one of the family was despatched for an emetic; but by the time it was procured

the symptoms had abated so much that it was not deemed necessary to administer it. The cough loosened, and tough albuminous material was coughed up in large irregular masses, which readily spread out into flakes on being spat into water. The inhalations were continued every two hours that night, and three times the following day, after which I found no other topical application necessary. The inhalations were continued from time to time, a mild purge administered, and turpentine stupes applied to the back of the neck and the breast. The child steadily improved and recovered.

Dr. Collins informs me that he has tried lime-water inhalations in several cases of simple spasmodic croup, with success in every instance.

### *Diphtheria.*

LEWIN records in detail (*op. cit.* 466–499) eighteen cases of diphtheria treated by him, in part with inhalations, of which number fifteen recovered. These results being remarkable, I consider it well worth while to insert a synopsis of the cases, their treatment, and the result.

*Case I.* Margaret H., æt. 4. Treatment began on the tenth day of the disease, when the symptoms were as follows: *April 14—evening.* Pulse, 120; respiration 30; urine somewhat albuminous; sleep good; voice a little hoarse; deglutition somewhat impeded; cough trifling; lymphatics of the neck on the right side swollen; right tonsil covered with a deeply penetrating pseudo-membrane; larynx copper-colored; epiglottis swollen. Treatment: internally, chlorate of potassa ʒj to fʒv of water; locally, chromic acid ʒjss. to fʒj applied to the deposit; by inhalation, chlorate of potash ʒj to fʒvj.

Under this treatment the condition gradually improved, and the child was about to be discharged from observation, when, on the fifth day of the treatment, she was attacked with rigors in the evening, followed by fever; the next morning a deeply penetrating white exudation was observed on the left tonsil, which seemed to be drawn more deeply towards the larynx. The same treatment was reinstituted, and after a few days the child recovered entirely.

*Case II.* Hannah F——, æt. 5, the sister of two boys recently dead of diphtheria. She was seen on the third day of the disease, when, May 29, her condition was as follows: pulse 120; respiration 28; urine slightly turbid; sleep good; voice and deglutition normal; no cough; lymphatics on right side swollen; grayish-white exudation on the right arch of the palate and upon the right tonsil, dipping down deep to its lower surface; larynx copper-red; the mucous membrane, especially upon the upper surface of the epiglottis, somewhat swollen. Treatment: internally, chlorate of potassa  $\mathfrak{3j}$  to  $\mathfrak{f\mathfrak{3}iv}$ —a tablespoonful every hour; locally, chromic acid  $\mathfrak{5ij}$  to  $\mathfrak{f\mathfrak{3}j}$ ; by inhalation, chlorate of potassa  $\mathfrak{5ij}$  to  $\mathfrak{f\mathfrak{3}viiij}$ . By the 3d of June all the phenomena of disease had disappeared; but on the 7th of June an alteration of the voice was noticed, and a difficulty in deglutition, fluids returning by the nose, owing to a partial paralysis of the soft palate, of which there was, under the use of iron, gradual restoration in four weeks.

*Case III.* Otto F., æt. 3., brother of Case II. On the second day of the disease, May 29, he presented the following condition: pulse 112; respiration 26; sleep good; voice normal; deglutition somewhat impaired; some cough; lymphatics of neck swollen on both sides;

exudation on both sides of the pharynx, on the left side extending further towards the entrance into the larynx; larynx somewhat congested, grayish-yellow slimy exudation on the free border of the epiglottis. Treatment: internally, Potas. chlor.  $\mathfrak{5j}$  to  $\mathfrak{f\mathfrak{3}iv}$ , a papspoonful every two hours; locally, cauterization with chromic acid  $\mathfrak{5ij}$  to  $\mathfrak{f\mathfrak{3}j}$ ; by inhalation, potass. chlor.  $\mathfrak{5ij}$  to  $\mathfrak{f\mathfrak{3}viii}$ . Recovery prompt.

*Case IV.* Alfred B., æt. 8. On the third day after having been taken with fever he began to cough; this increased and assumed a barking tone. Tonsils covered with whitish-gray matter. Improvement followed an emetic and the application of leeches; but on the next day the fever increased, the cough increased, hoarseness came on, and the medical attendant administered an emetic, again applied leeches, and gave two grains of calomel every other hour until twelve grains had been taken. June 12, the fifth day of the disease, the condition was as follows: pulse 126; respiration 34; no albumen in urine; sleep broken by a barking cough; some dysphagia; lymphatics swollen on both sides of neck; the velum on the right side, from the attachment of the uvula over to the lower end of the tonsil, covered with gray-white pseudo-membrane; left tonsil slightly affected; the entire larynx, as far as could be seen, highly reddened, the upper surfaces of the arytenoid cartilages covered with thin gray-white exudations; the vocal cords could not be seen. Treatment: internally, Potass. chloras.  $\mathfrak{5jss}$ . to  $\mathfrak{f\mathfrak{3}iv}$ ,—a papspoonful every two hours; locally, cauterization with chromic acid  $\mathfrak{5ij}$  to  $\mathfrak{f\mathfrak{3}j}$ ; by inhalation, potass. chloras.  $\mathfrak{5ij}$  to  $\mathfrak{f\mathfrak{3}viii}$ , two ounces every two hours. On the 15th the child was pronounced well.

*Case V.* Hannah E., æt.  $3\frac{1}{2}$ , very delicate. Condition July 10th as follows: pulse 96; resp. 24; some albumen in urine; sleep tolerable; considerable hoarseness; a moderate degree of dysphagia; frequent cough; lymphatics somewhat swollen; considerable and deeply penetrating exudation upon both tonsils and arches; mucous membrane of entire larynx and commencement of trachea, bright red; epiglottis somewhat swollen. Treatment: internally, potass. chlor.  $\mathfrak{3ij}$  to  $\mathfrak{f\mathfrak{3}v}$ ; locally, cauterization with chromic acid  $\mathfrak{3ij}$  to  $\mathfrak{f\mathfrak{3}j}$ ; by inhalation, alumen  $\mathfrak{3ij}$  to  $\mathfrak{f\mathfrak{3}vii}$ . The next day the voice had improved, the epiglottis was more swollen and inflamed, but showed no exudation; internal treatment and inhalation as on the day previous; the epiglottis and arytenoid cartilages were touched with nitric acid,  $\mathfrak{3ss.}$  to  $\mathfrak{f\mathfrak{3}j}$ . By the 13th every function was in order. Recovery complete.

*Case VI.* Hulda H., æt. 5. Second day of disease, Aug. 24, condition as follows: pulse 140; resp. 32; no albumen in urine; sleep disturbed; voice hoarse; considerable dysphagia; cough frequent and hoarse; lymphatics much swollen on both sides and painful upon pressure; both tonsils, the uvula, and a portion of the arches much swollen, and covered with thick leathery pseudo-membrane; epiglottis swollen, considerable white-gray deposit on its upper surface, receding on the right side toward the aryteno-epiglottic ligament. Treatment: internally, potass. chlor.  $\mathfrak{3ij}$  to  $\mathfrak{f\mathfrak{3}vj}$ , a tablespoonful every second hour; locally, cauterization with acid chrom.  $\mathfrak{3ij}$  to  $\mathfrak{f\mathfrak{3}j}$ ; by inhalation, alum  $\mathfrak{3ss.}$  to  $\mathfrak{f\mathfrak{3}vj}$ , two ounces every second hour. On the 28th the condition had become as follows: pulse 120; resp. 28; much albumen in urine; lymphatic swellings less pain-



ful on pressure ; right tonsil almost entirely clean, left, still covered ; epiglottis clean. Treatment : internally, liq. ferri sesquichl. 5 drops every third hour ; locally, touching with arg. nit.  $\mathfrak{Dj}$  to  $\mathfrak{f\tilde{3}j}$  ; by inhalation, alum as before. By the 30th, convalescence was established, and the case went on to complete recovery.

*Case VII.* August M., æt. 10, living in a dirty unhealthy cellar ; rather delicate, but had always been well. Aug. 26, took cold running about the streets, felt unwell, with loss of appetite. Dysphagia began early on 27th. Aug. 30, condition as follows : pulse 140 ; resp. 36 ; no albumen in urine ; sleep restless ; voice hoarse ; considerable dysphagia, with pain in the right ear on eating ; lymphatics on both sides swollen and painful to pressure ; the uvula lengthened and thickened, and as if covered with kid ; pseudo-membrane upon both tonsils and palatine arches, and sharply defined from the sound tissue ; epiglottis much swollen, and on the right side of its free border, covered with pseudo-membrane ; vocal cords normal ; nostrils much inflamed. Treatment : internally, potass. chlor.  $\mathfrak{3ij}$  to  $\mathfrak{f\tilde{3}vj}$ , a tablespoonful every two hours ; locally, cauterization with chromic acid  $\mathfrak{3ij}$  to  $\mathfrak{f\tilde{3}j}$ . Inhalations of alum  $\mathfrak{3ss.}$  to  $\mathfrak{f\tilde{3}vj}$ ,  $1\frac{1}{2}$ –2 oz. every two hours. On the 2d of September, 5 drops of liq. ferri. sesquichlor. every 3 hours was substituted for the chlorate of potassa. Recovery prompt.

*Case VIII.* Helen M., æt. 8, sister of Case VII. Dec. 1, condition as follows : pulse 132 ; resp. normal ; sleep uneasy ; considerable dysphagia ; lymphatics on both sides swollen, and painful on pressure ; tonsils and arches covered with pseudo-membrane ; epiglottis some-

what inflamed. Treatment: internally, potass. chlor.; inhalation; locally, chromic acid. Complete recovery.

*Case IX.* Louise M., æt.  $3\frac{1}{2}$ , sister of Nos. VII and VIII. Tonsils not inflamed, but swollen, and upon them isolated spots of pseudo-membrane. The spots were touched with chromic acid; a solution of alum was inhaled, and the next day all the local symptoms vanished. No general treatment required in this case.

*Case X.* Mary P., æt. 15. Jan. 25, fourth day of the disease, condition as follows: pulse 128; resp. 38; urine slightly albuminous; sleep poor; voice hoarse; severe dysphagia; moderate cough; lymphatics on both sides swollen; on the right tonsil, and right soft palate, white matters, but as in this case nitrate of silver had been applied locally the day before, it is impossible to determine whether the appearance denoted diphtheritic exudation, or the escharotic effect of the nitrate of silver; larynx perfectly clear, not even injected. This case was treated with chlorate of potassa internally, cauterization with chromic acid after the exudation had spread somewhat, and inhalation of a solution of alum. Recovery was prompt in a few days.

*Case XI.* Bertha E., æt. 4. Dec. 24, appeared pale, lost appetite, and complained of pain in swallowing. Examination showed pseudo-membrane on both tonsils, on velum, and on posterior wall of pharynx. Treatment was immediately instituted by local cauterization with chromic acid, and the administration of chlorate of potassa internally. Dec. 28, condition as follows: pulse 104; resp. 24; urine contained considerable urates, no albumen; sleep good; voice somewhat hoarse; trifling dysphagia; trifling cough; lymphatics very much swollen and painful; posterior wall of pharynx, uvula, both

arches, and tonsils, fully covered with pseudo-membrane; larynx very much inflamed, as also epiglottis and false vocal cords; true cords free. Treatment: internally, liq. ferri sesquichlor. 5 drops every two hours; locally, cauterization with chromic acid; by inhalation, alum. Condition gradually improved, and on Jan. 1st, 1864, pulse 100, resp. 16; lymphatics still swollen and painful. Treatment: internally, decoct. cinch. (ʒij to fʒiv), acid hydrochl. fʒss., and Tokay wine; inhalations of chlorate of potassa ʒj to fʒvij. Jan. 2d, pulse 140; resp. 28 and stridulous; voice very hoarse; pseudo-membrane on lower surface of epiglottis, and on arytenoid cartilages. Treatment: internally, liq. ferri sesquichl. and Tokay wine; cauterization with chromic acid, ʒj to fʒj. Three paroxysms of marked dyspnœa at night. Jan. 3d, pulse 136; resp. 24, and freer; some albumen in urine, and a good deal of urates; cough increased but dry; lymphatics still swollen; local appearances unchanged. Treatment: internally, potass. nit., potass. bicarb. āā ʒj, to fʒiv of Tokay wine; cauterization as before, followed by an hour's vomiting of slime. Coughed up in the night thick yellow-reddish membranes, tinged with blood on their internal surfaces, and which from their form must have come from the trachea. Jan. 4th, pseudo-membrane also upon the false vocal cords. Treatment: internally, liq. ferri sesquichl.; by inhalation, potass. chlor. A short paroxysm of dyspnœa at night. Jan. 5th and 6th, pulse 135; resp. 32: aphonia; pharynx almost clean; pseudo-membrane only on epiglottis. Treatment: the same. Similar dyspnœa at night. Jan. 9th, pulse 160; resp. 40; marked stridor; urine scanty, more albumen; cough severe and whistling; vocal cords covered with

diphtheritic deposits; pharynx entirely clear; circumscribed pneumonia on right side with rusty sputa. Treatment: the same. Jan. 10th, pulse 130; resp. 32; no stridor; urine containing much albumen, filling half the test-tube. Treatment: internally, sodæ nit., carb. nit.  $\bar{a}\bar{a}$   $\bar{5}j$  to  $f\bar{5}iv$ ; otherwise the same. Very little rusty sputa. After two days further, improvement began and continued to complete recovery.

*Case XII.* C. D., laborer, æt. 46. June 7th, 1864, condition as follows: pale, feeble, and emaciated; diphtheritic chancre on foreskin and glans penis, both of which are half destroyed; diphtheritic pharyno-laryngitis. Posterior wall of pharynx, soft palate, uvula, both arches, covered with membrane so adherent that an attempt to remove it with the forceps produced hemorrhage; the middle portion of both lips in great extent partly covered with diphtheritic deposit, partly with adherent sanguinolent effusion; lymphatics at angle of lower jaw, both sides, much swollen. Epiglottis swollen to three or four times its natural thickness, covered on both faces with thick pseudo-membrane; so also, but more thinly, the false vocal cords and the arytено-epiglottic ligaments. True vocal cords reddened, a yellowish-white exudation at the lower attachment of the left cord. No albumen in urine; voice hoarse; a good deal of hoarse cough; temperature  $38.4\text{ R.}$ ; pulse 80, resp. 24. Treatment: locally, acid chr.  $\bar{5}ss.$  to  $f\bar{5}j.$  aq. dest., detaching a piece of leathery membrane an inch in length and almost the same size in breadth; inhalations of potass. chlor. gr. x to  $f\bar{5}ij.$  by the steam nebulizer. Internally, decoct. cinch. ( $\bar{5}ij$  to  $f\bar{5}iij.$ ), with vin. rubri.  $f\bar{5}iij.$  æth. spts. nit. gtt. x, acid phosp.  $\bar{5}j.$  clæos. citri  $f\bar{5}ss.$ ; a tablespoonful every two hours.

Spirits of camphor locally to the chancres. July 16th, recovered.

*Case XIII.* Marie J., æt. 13. Taken with diphtheria on Christmas eve, 1863; diphtheritic membrane on both tonsils, and the right posterior palatine arch, from which a small diphtheritic ulceration reached to the anterior border of the epiglottis. The parts were touched twice a day with chromic acid 5ij to f3j, and on the fourteenth day, had improved enough to pass from observation. January 19th, she returned under treatment for difficulty in swallowing solids, and alteration in voice; she remained under treatment until March 17th, and eventually recovered completely.

*Case XIV.* Hugo L., æt. 9, had some exudation on the tonsils, and some specks on the uvula. These were touched with chlorate of potassa in glycerine, and sulphate of copper was given as an emetic. Suffocation set in, and tracheotomy was thought necessary. Laryngoscopy revealed trifling exudation upon the vocal cords, and inflammation of the posterior wall of the larynx, but there was no mechanical obstruction to respiration. Inhalation of the watery vapor from emollient decoctions were employed, and subsequently inhalations of oxygen gas, with good results; and eventually the child recovered.

*Case XV.* Mrs. W., æt. 23, had some alteration of voice following an attack of diphtheria. This was found to depend on a small warty excrescence situated near the attachment of the right vocal cord. The cords were somewhat thickened, and the general mucous membrane injected. The topical treatment consisted in touching the excrescence with iodine in glycerine, tannin, and nitrate of silver, and inhalations of a solu-

tion of tannin, and later of ol. pini pumelion. The ex-crescence diminished, and the voice regained its timbre, but at last accounts was still incompetent for the purposes of vocal music.

The three following cases terminated fatally. In none of them was the local treatment instituted until after the diphtheritic process had already extended more or less into the larynx, or at least over the upper surface of the epiglottis.

*Case XVI.* F. J., boy, æt.  $8\frac{1}{2}$ . Christmas, 1862, was attacked with tonsillitis, which was cured by local treatment in fourteen days. February 26th following, was attacked with severe coryza, with parotitis, swelling of the lymphatics, and severe fever. Deglutition becoming painful, an examination of the fauces showed the velum swollen, dark-colored, and covered here and there with grayish spots. The pseudo-membrane soon extended towards the posterior pharyngeal wall, and from the attendant dyspnœa and croupal cough sound, seemed to have penetrated into the larynx. An emetic of antimony and ipecac afforded relief, with the expulsion of a fragment of membrane; but the disease soon assumed a typhic character, when acid hydrochl. (℥ss. to f℥x) was administered inwardly, and a topical application of the muriatic acid was made by the pencil.

March 1st, the condition was as follows: pulse, 176, small and weak; respiration, 60, inspiration rough and rattling, expiration shorter and less stridulous; countenance pale; lips, clear red, with some spots less red; belly, tumid; parotids and lymphatics, swollen and painful; mucous râles over the chest; velum, tonsils, arches, posterior pharyngeal wall covered with

adherent exudation, exposing bloody spots when removed; epiglottis swollen to the size of the middle finger, leaving but a small slit sideways for the passage of air; in the middle of its anterior border, an excoriated spot reaching to the lower surface, partly bloody and partly covered with gray-white exudation; a great deal of albumen in urine. Treatment: internally, Liq. ferri sesquichl., ℥j to f̄3x; locally, cauterization with chromic acid, the retching produced by which ejected some slimy whitish-gray masses, tinged with blood; by inhalation, argent. nitr., gr. ss. to f̄5j, an ounce every hour through Bergson's apparatus. In the night of March 1-2, there was severe dyspnœa, with marked stridor attendant upon both acts of respiration; pulse, 206; respiration, 30; strong cardiac impulse; extremities cool; intelligence disturbed; a great deal of albumen in urine. Now, half a drachm of unguent. hydrarg. cinereum was rubbed in every two hours. In the evening, the dyspnœa had somewhat reduced, and the child was more comfortable; skin dry, but not hot; epiglottis free from membrane, but more swollen; from between the epiglottis and posterior wall of pharynx, a loose piece of membrane was removed by the finger. An attempt to induce retching by mechanical irritation, so as to expel some more of the membrane, failed, a little thick slime only being expectorated. At eleven clock at night, the difficulty of respiration became much increased; pulse rose to 212, and great weakness ensued; and at two o'clock the patient died comatose.

*Case XVII.* Fritz M., æt. 8, whose two sisters had contracted diphtheria a few days previous, was attacked with the disease, the local process destroying the ton-

sils by ulceration, and attacking the glotto-epiglottic ligament. The swollen epiglottis was attacked on its laryngeal surface by the diphtheritic process, as were also the ary-epiglottic ligaments. The disease progressed, and the child died. The treatment consisted in the administration of chlôrate of potassa; cauterization with chromic acid; and the inhalation at first of tannin, and subsequently of sesquichloride of iron, at which time the same remedy was substituted internally also.

*Case XVIII.* Anna M., æt. 14, with diphtheritic exudation upon pharynx, laryngeal face of epiglottis, and arytenoid cartilages; urine loaded with albumen. Improvement. On the twenty-second day, inflammation (diphtheritic?) of the stomach; urine scanty, with a good deal of albumen; paralysis of velum, and later of œsophagus; nourishment by the stomach-tube; hydrothorax; hydropericardium. Death on thirty-third day.

This case was treated at first with sesquichloride of iron internally; cauterization with nitrate of silver and chromic acid; and inhalations of a solution of tannin, to which after a few days conium was added, about a drop and a half to the ounce, while sulphate of quinine was added to the iron treatment. Various other treatment, such as the administration of digitalis, nitrate of potassa, &c., and the inunction of a mercurial ointment, was employed to meet certain indications.

Lewin mentions that the local application of the chromic acid in all these cases, produced retching, often violent and sometimes continuing for some time. It is probable that this mechanical effect contributed towards a good result. The inhalations seem to have answered



a good purpose; probably by keeping up a supply of watery matter, and thus assisting in the expectoration of the exudation before its coagulation into membrane. At the same time it will be perceived that systemic medication was not neglected, although much stress cannot be laid on the chlorate of potassa, which was the remedy most frequently employed internally, for in this country its internal administration has not proved adequate to resist the systemic poisoning, or even produce much effect upon the local trouble.

The cases are worth recording, on account of the remarkable result—a cure in fifteen cases out of eighteen—the three fatal cases being all of them more unfavorable from the outset than the others, and farther advanced in progress before the institution of treatment, leaving the inference that even these cases might have terminated differently had they been placed under this routine earlier.

I hardly think the cases of diphtheria, as met with in this country, would be amenable to the same treatment, unless at the same time the system were continuously supported by ordinary stimulants.

M. KÜCHENMEISTER, of Dresden, has published a case of diphtheritic pharyngo-laryngitis in a child of three years and a half old, treated with inhalations of *lime-water* with complete success (*Brit. & For. Med-Chir. Rev.*, July 1865).

Dr. DA COSTA, of Philadelphia (*op. cit.*, p. 32), has watched, in two cases of diphtheria, the action of lime-water on the visible deposits.

In the first case, that of a lady, seen in consultation

with her physician on the fifth day of her confinement, the deposit covered the roof of the mouth, the half arches, and part of the wall of the pharynx. There was also—and indeed the progress of the case placed the matter beyond doubt—reason to believe that nasal diphtheria existed. She was taking chloride of iron, full nourishment, and stimulants. A stream of pulverized lime-water, about eight times stronger than that official in our Pharmacopœia—the liquor calcis saccharatus of the British Pharmacopœia—was directed upon the affected part by means of an excellent hand-ball atomizer for three or four minutes at a time. The treatment was carried on every few hours, but no perceptible influence on the membrane could be detected. The application was cleansing and very grateful, particularly so when thrown up the nostrils. The case terminated fatally, the membranes in the mouth remaining in a very thick layer.

The second case was that of a gentleman thirty-five years of age. Here there was no nasal diphtheria, nor were the constitutional symptoms by any means so grave; and after the disappearance of the membranes, which took place in about nine days, convalescence was rapid. As local treatment, early in the affection, a strong solution of sulphate of copper was employed. But both at the time, and afterwards, Dr. Da Costa made use of atomized solutions of lime, in the same manner as in the preceding case, and not hot. The remedy was again very grateful and cleansing; yet, though the same spot in the left half arch was repeatedly selected on which to throw the solution, no perceptible effect in thinning the deposit could be noticed from its influence.

It will be remembered that inhalation of lime-water has been proposed in cases of diphtheria, on account of its supposed solvent powers upon the diphtheritic membrane *in situ*.

Dr. JAMES COLLINS, of this city, has furnished me with the following notes of a case of diphtheria, in which lime-water inhalations were administered, under his treatment:

Wm. M——, æt. 3. When called to this little patient, September 24, 1866, I found him pallid, struggling for breath, with cold extremities, pulse 120 and feeble, and marked diphtheritic deposit lining the fauces and covering the tonsils. According to the mother's statement, the child had been "sickish-like" for ten days, but not sick enough to cause her to send for the doctor. I removed several large flakes of diphtheritic membrane with the finger very readily, gave injections of quinia and beef tea, ordered wine and water, and administered lime-water inhalations. The effect of the local treatment seemed to be quite marked. The difficulty of breathing was greatly relieved; the pulse became less frequent and fuller; the skin became warmer, and for a time the child seemed to be relieved. During the night he again became worse and died.

#### *Œdema of the Glottis.*

TROUSSEAU (*Clinique Médicale de l'Hôtel Dieu*, Paris, 1861, p. 475) records a severe case of œdema of the glottis promptly relieved by inhalations of tannin. A woman, æt. 21, who had recovered from puerperal peritonitis six weeks previously, was admitted into the hospital with great pain in the throat, swollen tonsils,

and difficulty in swallowing. The angina, already of ten days' duration, increased rapidly in severity, at times impeding respiration to such an extent as to threaten life. Inspiration was accompanied by laryngo-tracheal râles, although respiration was free, and the voice retained its natural tone. The countenance of the patient was like that of one threatened with asphyxia; the pulse extremely small; the submaxillary region tumid and painful. The pharyngeal mucous membrane was very much inflamed, and examination with the finger revealed an œdematous swelling of the epiglottis and the aryteno-epiglottic folds. The diagnosis was, of course, œdema of the glottis.

Inhalations of a strong solution of tannin from the apparatus of Mathieu were at once instituted and repeated hourly; under the influence of which, the attack moderated, and on the following day there was marked improvement,—but a single suffocative paroxysm ensuing, and that of less intensity,—with greater freedom of respiration, and disappearance of the râles. The swelling of the epiglottis and of the aryteno-epiglottic folds had markedly diminished likewise. The respiration soon became normal, and only a single suffocative paroxysm occurred in twenty-four hours; and in four days the patient left the hospital advanced in convalescence.

Trousseau also reported to the Academy of Medicine another case of œdema of the glottis likewise cured by inhalations of a solution of tannin.

I have myself treated two cases of œdema of the larynx. One was the case of a lady in this city, who was carried out insensible from the upper story of a house on fire, in which very combustible materials, as soaps, oils, &c., were burning. The dense hot smoke

from these substances had been inhaled, and produced an intense laryngitis with complete aphonia. I was called to the patient a few hours after the occurrence, and found her exhausted, in great distress from dyspnœa, and threatened with death from suffocation. A solution of the watery extract of opium was immediately procured, and an ounce administered warm by inhalation, with relief to the suffering, and, to some extent, to the dyspnœotic paroxysms. The inhalations were repeated every half hour, for four or five times, until respiration had become markedly relieved, when they were given in a more diluted form every two hours. I paid the patient five visits within seven hours, and at each visit administered the inhalations myself, so as to insure the proper administration of some of them. The expressions of gratitude for relief were such as to leave no doubt as to their good result, and the patient would not have parted with the apparatus under any consideration. The opium inhalations were continued three or four times a day for a week, when the acute symptoms of laryngitis having subsided, tannin was substituted, with the result of return of voice.

The second case, that of a widow in this city, was sent to me by my friend and colaborer, Dr. D. D. RICHARDSON. The laryngitis in this instance was very painful, and complete aphonia had existed for five days. There was very great dyspnœa, so that the patient gasped for breath as she entered my apartment. She said that, several times, while coming to visit me, she felt as though she would not be able to breathe any longer. I made a laryngoscopic examination, and found the aryteno-epiglottic folds very much swollen and inflamed, and the false vocal cords so œdematous,

as to entirely cut off a view of the true cords. This appearance was recognized by Dr. Henry V. Gray, of Petersburg, Va., who happened to be in my office at the moment, a gentleman who was at that time, himself familiar to some extent with the use of the laryngoscope. In order to relieve the intense distress of the patient, I placed her before an apparatus from which a patient but a few minutes before had been inhaling a warm solution containing of laudanum f5j to f5j; and set the pump going, while I was getting out my scarificator, with the intention of scarifying the swollen structures. She could not have taken above half a dozen inspirations, when she heaved a long sigh of relief, followed by a prolonged oh! and, continuing the inhalation, in a few minutes the dyspnœa had vanished, and the voice had returned, rendering scarification unnecessary; for on a second laryngoscopic examination, the tumefaction was so much reduced as to forbid surgical interference. The result was unanticipated by myself, and Dr. Gray exclaimed, "Why, Doctor, that is magic!"

A dose of sulphate of magnesia was ordered for the patient, and she was directed to use embrocations of the oil of turpentine externally for a few days. The trouble rapidly subsided after the single inhalation, so that its repetition was not requisite.

#### *Stricture of the Glottis.*

Dr. SEMELEDER, of Vienna, relates (*Wochenblatt der Zeitschrift der K. K. Gesellsch. d. Aerzte in Wien.*, No. 1, 1864, *Lewin, op. cit.*, p. 289) a case of stenosis of the larynx, supervening during the healing of an

incised wound, completely relieved by inhalations of a solution of alum.

A woman, æt. 46, endeavoring to commit suicide, cut her throat, with a razor, about the position of the upper border of the thyroid cartilage. The larynx was opened close under the epiglottis, and thence the wound communicated directly with the pharynx. The voice was low and difficult, swallowing painful, and on an attempt to drink, some drops would flow down between the arytenoids upon the vocal cords, and thence out of the wound.

On the fourth day, an elastic catheter, and over this a double canula of hard rubber, was placed within the glottis through the wound, with relief to respiration and expectoration. After the condition of the patient had gradually improved to a remarkable degree, suddenly, on the forty-ninth day, she was seized with difficulty of breathing, following exposure to cold, accompanied with swelling of the vocal cords, true and false, and the production of a stenosis of the larynx. To relieve this, the inhalation of a nebulized solution of alum in water was employed, beginning with ʒj to ℥j of water, and later increased to ʒij, with the addition of a few drops of tr. opii, in order to secure the astringent effect of the inhalations.

The patient inhaled, once, daily, six to eight minutes, the canula being closed. She improved so much that the swelling and congestion of the whole laryngeal structures, as well as the epiglottis, gradually became reduced. Immediately after each inhalation, the voice was much louder than it had been before. After three weeks of these inhalations, the glottis had again become so movable, that the canula was withdrawn from

the wound. The patient breathed freely without the canula, and the voice gradually improved.

### *Aphonia.*

Dr. JOHANN SCHNITZLER reports (*op. cit.*) a case of complete aphonia cured by inhalations of alum. For two years the patient had been subject to recurrent hoarseness, until, some six or eight months before treatment by inhalation, the voice suddenly left, and the aphonia remained constant. The laryngoscope showed marked swelling of the vocal cords, and of the mucous membrane of the larynx generally. Nothing abnormal was detected in the lungs. This physical condition was confirmed by Semeleder. Inhalations of a solution of alum were instituted, and on the second day the voice was louder; and in eight or nine days the patient had recovered a pretty good voice, though hoarse, which became clearer and louder every day. The gradual diminution of the catarrhal swelling of the vocal cords was watched with the laryngoscope.

WALDENBURG (*op. cit.*, p. 332) reports the loss of voice in a case of laryngitis and tuberculosis, in which the aphonia was improved under the inhalation of a solution of common salt; gr. ij to the ounce.

FIEBER (*op. cit.*, p. 119) reports a case of laryngo-tracheal catarrh, with almost complete aphonia, in which the voice soon returned, under the inhalation of a solution of tr. opii gtt. vj, zinci. sulph. grs. vj, to the ounce of water.

In aphonia from paralysis of the vocal cords, now usually treated by the local application of electricity, Dr. *Klimbacher* employed with success in addition (*Fieber*, *op. cit.*, p. 119) inhalations of a solution of tannin.



LEWIN also employed in addition to the Faradization, inhalation of a solution of the sesquichloride of iron, with good result in a case of pharyngo-laryngitis, with occasional hysterical aphonia.

SIEGLE (*op. cit.*, p. 70) employed inhalation of a strong solution of alum for three days, with partial return of the voice, in a case of hysterical aphonia, of several years' duration, the cure being subsequently rendered permanent by local Faradization.

Siegle (*op. cit.*, p. 71) also relates a case of *rheumatic aphonia* in a student, whose voice improved day by day under several inhalations daily of hot vapor of water, so as to leave nothing more to be desired on the eighth day; and he mentions a similar case reported by Lewin, which had not improved under Faradization of three or four weeks' continuance, and in which prompt and permanent relief followed the hypodermic use of strychnia in doses gradually increased to half a grain.

Where aphonia is a result of acute or chronic inflammation of the vocal cords, with swelling or induration of their structures, the remedies applicable to the local condition of the parts will cure the aphonia.

I treated a case of aphonia of several months' duration, the past winter, in a young lady who, after failure of the ordinary methods, had been treated by inhalations of tannin daily for ten weeks, without result, and who was sent to me as a case of nervous aphonia. I tried for a day or two, inhalations of a watery solution of iodine, from Mathieu's (cutler) apparatus on the Sales-Girons principle, with a slight improvement of the voice, but seeing on examination with the laryngoscope, that the aphonia was not nervous, but due to chronic inflammation of the vocal cords, with thickening, I re-

sorted to local applications of a strong solution of nitrate of silver, applied by the probang, and this being ineffectual, after two or three trials, I applied a solution of the corrosive sublimate, 60 grains to the ounce, with restoration of the voice, which, under the continuance of the treatment, gradually improved in timbre, and with final relief from all the nervous symptoms which had ensued under fears of consumption, and the mental dread of an incurable affection.

In one case of aphonia from the inhalation of hot smoke and flame during exposure in a house on fire, after the more acute symptoms of laryngitis had subsided, I employed inhalations of tannin for the laryngeal trouble, and during their employment, the patient recovered her voice.

In several other cases contracted under the same circumstances, which, under my own observation, were treated by Dr. W. W. Keen of this city, the same result followed the same treatment. In these cases, however, the relief of the local trouble causing the loss of voice in the first instance, naturally relieved the aphonia.

I have in this way relieved several incidental aphonias dependent on laryngitis, bronchitis, &c.

### *Whooping-Cough.*

Dr. WEDEMANN, of Jena, assistant in the clinic of Prof. Gerhardt (quoted by Fieber, Siegle, and Lewin, *op. cit.* p. 278-85), reports a number of cases treated by inhalations of nebulized medicaments, and among them a case of whooping-cough in a child seven years of age, in whom the intensity of the spasms of cough began to diminish after the very first inhalation of a

solution of sesquichloride of iron, gtt. iij to the ounce (Wedemann, *op. cit.* p. 42).

FIEBER (*op. cit.* p. 116) reports the case of a child four years of age, in whom the paroxysms threatened suffocation, and in which the disproportion between the objective symptoms and the subjective phenomena leading him to consider the affection a disease of the par vagum, rather than of the minute bronchi and air cells, he resolved to employ inhalations of the following mixture: Ext. hyoseyami sem. alcoh. gr. vj, ol. olivæ, f 5j, pulv. gummi arab. 5ss., aq. font. lbij. After eight days' use, the disease had become so mild that further attendance was unnecessary. The emulsion was very well nebulized. Treatment began April 23d, 380 inhalations (*inspirations*) readily taken; no cough, narcotic effect produced. 24th, same treatment; four spells at night, no blood in sputa; next night two paroxysms of cough. The cough worse in daytime while the child is moving about. 25th, 380 inhalations. 26th, one spell during the night, less intense than before; 380 inhalations. 27th, child slept all night, 380 inhalations. This treatment was kept up until the 30th, with cessation of all the disagreeable symptoms.

SIEGLE (*op. cit.* p. 73) reports the cases of two sisters, aged respectively three and five years, in whom the disease had lasted for five days. He employed inhalations of a solution of alum, a drachm to six ounces of water, twice daily, ten minutes at a time. By the night of the very first day, the paroxysms had abated in violence, and the cases were completely cured; the younger on the eighth day of treatment, and the other a few days later.

Dr. ROHN, of Hanau (*Wien. Med. Wochenschrift*, xvi, 52, 53, 1866), was led to the employment of inhalations

of a solution of nitrate of silver in whooping-cough, in consequence of the result of several laryngoscopic examinations of adults and larger children, while suffering with this affection. He found the mucous membrane, covering the anterior wall of the lower portion of the laryngeal cavity and the commencement of the trachea, hyperæmic in a marked degree, the vocal cords sparkling white and in marked contrast to the intense red of the subglottic region. He therefore considers that the lower laryngeal space, and the commencement of the trachea and the upper portion of the trachea, is the seat of catarrhal inflammation during the spasmodic stage of whooping-cough; and he is confirmed in this view by the uniform statements of adults and larger children, that a peculiar severe irritation about the upper part of the windpipe precedes the spasm of cough which it excites. Dr. Rohn inquires whether the existence of the catarrh at this point is not the true cause of the peculiar paroxysms of cough; and if the irritation of the inferior laryngeal nerve, which is composed of sensory fibres, will produce the same result with irritation of the internal filaments of the superior laryngeal nerve. Concluding, therefore, that the commencement of the spasmodic affection might also be due to a catarrhal condition of the mucous membrane of the central and smaller bronchi, he resorted to the therapeutical effect of inhalations, in order to reduce the inflammatory process by a local caustic action. He has convinced himself that such treatment resulted favorably in the cases of six children over four years of age, and in two grown persons. The medicament was a solution of the nitrate of silver, gr.  $\frac{1}{2}$ –1 to the ounce of distilled water, according to the age of the patient, and the severity of

the affection. About half an ounce of the solution was inhaled once daily. All these cases were of from three to five weeks' duration, and either in the beginning of the convulsive stage, or at its maximum. Dr. Rohn states that after the first two, and at the furthest, after the first three inhalations, the cough became markedly diminished in violence and duration, and in all of them with an immediate abatement of the vomiting; that after the fourth and sixth inhalation, the general characteristic whooping-cough symptoms disappeared; leaving behind, at the most, but a slight simple catarrh. A still further experience convinces the investigator that at least with children over four years of age, who can be very well made to take the inhalations, other febrile complications of the respiratory organs do not contraindicate the inhalatory treatment. (*Schmidt's Jahrbücher*, Nov. 1866, p. 57.)

Further on this subject see Schmidt's *Jahrbücher*, July, 1866, p. 62, on the treatment of whooping-cough by inhalations of nebulized solutions of tannin, by vapors of turpentine, and, p. 63, by air breathed in the apartments for purifying illuminating gas.

### *Acute or Catarrhal Bronchitis.*

To be treated on the same principles as catarrhal laryngitis, only the inhalations should be increased in number, in strength of solution, and in duration; while the inspirations are to be made more slowly and deeply, so as to draw the fluid particles into the bronchial tubes.

Nebulized warm water often affords considerable relief and increases the facility of expectoration. In the

forming stage of acute bronchitis, sal ammoniac is an excellent addition to the warm water.

For the relief of pain, narcotic and mucilaginous solutions should be employed; to reduce secretion, astringents.

In *putrid bronchorrhœa*, in addition to astringent remedies, the balsams serve a useful purpose. Waldenburg and Lewin recommend particularly the tar-water in these cases, when there is no fever. Siegle recommends tannin, on account of its antiseptic qualities. Others recommend alum. Fieber speaks highly of the sulphate of zinc under these circumstances.

### *Chronic Bronchitis.*

In this affection particularly, inhalations have been highly recommended. In the ordinary form of the disease weak solutions of tannin, of alum, and of iron, appear to be the favorite remedies. Wedemann recommends very highly, a solution of tannin, two grains to the ounce, with the addition of one-twentieth of a grain of morphia. Siegle prefers the action of the tincture of the chloride of iron.

DA COSTA (*op. cit.* p. 34) narrates a severe case cured mainly by inhalations of alum, eight grains to the ounce, with the addition of six drops of the fluid extract of conium, the alum being gradually increased to the proportion of twenty grains to the ounce.

BEIGEL (p. 121) details a case in which inhalations, night and morning, of a solution containing two grains of alum and ten minims of laudanum to the ounce of distilled water, proved successful after the failure of many other remedies. He also details a severe case (p. 124) which he relieved by inhalations of tannin grs.

iiij, ext. hyoscyami. grs. ij, aq. dest. f℥j, night and morning, subsequently changed, on account of the taste, to sulphate of iron, four grains to the ounce; and also a case of chronic bronchitis, occurring after small-pox, which succumbed to inhalations three times a day, of alum, one grain to the ounce, with the addition of ten minims of laudanum.

FIEBER reports a case, of the variety simulating consumption, of twenty-five years' standing, which improved in a marked degree under the inhalation of a solution of sulphate of zinc, five grains to the ounce. In the dry variety of the disease, Fieber recommends his oleaginous mixture.

In this dry variety, the inhalation of warm water will often subserve a useful purpose by supplying moisture; and if it does not facilitate expectoration sufficiently, a little common salt, sal ammoniac, or chlorate or carbonate of potassa, may be dissolved in it. Inhalations of iodized water are often recommended in this affection, as are also weak solutions of the nitrate of silver.

Good effects occasionally ensue from the liq. iodinii compositus, ten to forty drops to the ounce of water, two and three times a day. If there coexist pain, of course the narcotics and sedatives may be added to the inhalation, but preferably in minute quantity. Inhalations, however, should be accompanied by external revulsion, and attention to diet, social and domestic habits, &c.

### *Hæmoptysis.*

The principal articles employed to restrain hemorrhages from the air-passages have been cold water, sesquichloride of iron, subsulphate of iron, tannin, alum, and ergot.

Cold water was first recommended by Fieber (*Allg. Wien. Med. Zeit.*, 1862, No. 16), who says that where it can be borne, the inhalation of cold water at a temperature of from  $8^{\circ}$  to  $10^{\circ}$  R., suffices in slight cases of hæmoptysis, and in cases of bloody sputa.

The solution of the sesquichloride of iron, is the remedy most frequently resorted to in hæmoptysis, on account of its well-known hæmostatic agency, coagulating the albumen of the blood into an insoluble clot, and thus preventing further escape of the blood. It is also absorbed by the bronchial mucous membrane, and is thus to be used in cases of anæmia, with an ulterior view as to its ordinary therapeutical effect. It is to be resorted to in threatening cases, but is contraindicated in the febrile states of phthisis, and in delicate individuals with great sensitiveness and irritability of the mucous membrane. Lewin mentions the case (*op. cit.*, p. 348) of a lady in whom the inhalation of a solution of the sesquichloride of iron employed for a profuse bronchorrhœa always induced a slight hæmoptysis, even when in the proportion of but half a drop of liq. ferri sesquichlorid. to the ounce of water.

In using these ferruginous inhalations, care must be taken to protect the teeth.

Lewin suggests the possibility of the iron exciting a plastic exudation in a pulmonary cavity, the same as when injected into the sac of a hydrocele, &c.

The strength of the solution used for the purpose of arresting hæmoptysis varies considerably with various authorities. From two to five grains to the ounce is ample, for a small proportion of iron will coagulate a large quantity of blood. Prof. Zdekauer employed a drachm to six ounces of water, half of which quantity was in-



haled at each sitting by means of Mathieu's instrument. And by the way, the instrument of Mathieu, if at hand, or the insufflator of Bergson with the double bulb, on account of the low temperature of the spray they produce, is preferable in these cases to the steam apparatus. In cases of great danger, where the patient's strength must be economized to the utmost, the proportion of iron in the solution can be increased, in order to diminish the time of inhalation.

Tannic acid also, coagulates the blood, is an astringent, and diminishes secretion. It is said to be less apt to excite inflammation than iron, and its influence is probably more continuous. It is indicated in the milder cases of hæmoptysis, the so-called passive hemorrhages, and when inflammation is present; also in cases where it may not be desirable to introduce iron into the blood; in the bloody sputa of bronchorrhœa, where it comes in play as an antiseptic. It can be administered in larger doses than the iron,—say from ten to twenty grains to the ounce.

Alum coagulates the blood, and is like tannin,—astringent and antiseptic. It is more suitable than tannin in acute inflammatory conditions; and not being absorbed by the mucous membrane, is indicated in cases where it is not desirable to impress the organism.

Other astringents, metallic and vegetable, have been employed in hæmoptysis, and serve a useful purpose, though they can hardly replace iron, tannin, and alum.

It must not be forgotten that many pulmonary hemorrhages cease promptly without the introduction of a hæmostatic; which fact renders it difficult, in ordinary cases, to judge of the exact value of the inhalations.

That ferruginous inhalations have often saved life by

promptly arresting hæmoptysis and keeping up contraction of the bloodvessels, is abundantly attested by the records of many hundred cases from the pens of the various observers.

One or two striking examples are introduced in illustration :

FIEBER (*op. cit.* p. 141) relates a remarkable case in a man whose whole family were predisposed to affections of the respiratory organs, and several of whom were suffering from pulmonary and tracheal troubles. About fifteen years previous, the patient, at that time twenty years old, while journeying in winter, was attacked with hæmoptysis and pneumonia. Various treatment had been employed for the cough, &c., without success. Dr. Wagner became acquainted with the patient in 1860. At that time he had an exceedingly severe cough, with profuse, bloody expectoration. The apices of both lungs were infiltrated with tubercles, the right one to a very great degree. The sound on percussion was dull, and the respiratory murmur almost entirely bronchial. The region under the right clavicle became more and more sunken in, slight pains in the right thorax and under the right shoulder-blade were complained of, and the patient emaciated greatly. Whey, cod-liver oil, and mild narcotics with quinine, were of benefit, so that after a while the patient felt like travelling and resuming his employments, but desisted from so doing on account of his catarrh and slight attacks of hæmoptysis. In the year 1861, the patient complained of a sense of weight in the right loin and the right testicle, which latter organ was enlarged, hard, uneven, and painful on pressure. This was attributed to strain at stool. All the emollient, soothing remedies, in connection with rest, &c.,

produced no effect. The diagnosis pointed to tuberculous infiltration. A suspensory had to be worn. The patient's appetite was always moderate; bowels constipated, requiring laxatives. He would lose flesh and regain it and lose it again. Continued speaking and physical fatigue were very well borne. Early in December the bronchial catarrh exacerbated and increased to a very great degree. At the same time he became subject to attacks of hæmoptysis of such vehemence that his life was in constant danger. This condition had remained, in spite of all remedies, for more than five weeks, when, on the 9th of January, inquiry was made of Dr. Fieber whether *it would be possible by means of inhalations to keep the patient alive for three or four days* to see his brother, whose arrival was expected at that time. Fieber found the patient in a state of great helplessness, hardly able to move himself, and barely able to converse. A thorough examination—which would have been superfluous—was impossible. All sorts of remedies had been so ineffectual that the patient had discarded medicine and contented himself by sucking enormous quantities of small pieces of ice. On the day, on the evening of which the inhalatory treatment began, four pints (*seitel*) of blood were expectorated. With little hope of good result, the inhalation was begun that 9th of January, the greatest care being necessary for fear of exciting even a moderate paroxysm of cough, which would have resulted in a hemorrhage which might have proved fatal. A solution of the sesquichloride of iron (which, by the way, had been given by the stomach with no better effect than anything else), two scruples to two pounds of spring-water, was placed in the second model of Charrière's apparatus, and only such pressure exercised as absolutely

necessary to nebulize the fluid. The patient was permitted to inhale this so cautiously that a quarter of an hour's rest was allowed after every fifth inspiration. Three such sets of inspirations were given in the forenoon and the like number in the afternoon, so that he took, daily, thirty inspirations. The number was subsequently increased to forty-eight, and the proportion of the iron increased to a drachm. The result was a happy one. On the 10th of January the patient expectorated only one pint of blood. The sputa remained bloody until the 14th, *and after that, they continued free from tinge.* The patient was of a very irritable temperament, and every irritation induced congestion to the lungs. This was the reason that later, after any considerable emotion, the sputa became tinged with blood, though this would quickly disappear. On the first day of February, a narcotic solution was substituted for the ferruginous one, in order to diminish the catarrhal phenomena. At the end of April the inhalations were discontinued. The strength of the patient, meanwhile, had so increased that he was subsequently able in the beginning of June to travel to Roznan for the purpose of undergoing the whey-cure; and there Dr. Polansky resumed the inhalations, employing tannin. Dr. Fieber saw the patient again at Vienna, in August; he had improved very much in appearance, and was about departing for Berlin to rejoin his relatives.

ZDEKAUER reported (*Wien. Med. Woch.*, 1861) a remarkable case of arrested hemorrhage, in which the presence of iron in the lung was demonstrated after death. This case is detailed by Lewin (*op. cit.* p. 240), and is as follows:

J. B——, an invalid soldier, was sick with Bright's

disease, with albuminuria and consecutive dropsy. Close examination revealed the existence, at the same time, of hypertrophy of the heart, and either insufficiency of the mitral valve, or atheromatous excrescences in the aorta. The diagnosis was difficult on account of the pressing upwards of the diaphragm by ascites; and the short, but rough respiratory murmur was so loud and difficult to restrain, that only an occasional systolic murmur could be heard; while percussion elicited the existence of an enlargement of the heart.

Milk, diuretics, nitrate of potassa, and other remedies, were all ineffectual. The dropsical exudation and effusion increased rapidly; the patient could only breathe when sitting in an arm-chair. One day he was attacked with suffocation, followed by a terrific hemorrhage, which seemed to have no disposition to cease.

The apparatus of Mathieu happened to be at hand, as well as a solution of the chloride of iron, so that the resort to inhalation was made immediately. The poor patient just about breathed, or rather gasped for breath, and in two minutes he had fainted. He was soon restored to consciousness by sprinkling cold water upon his face, and he was made to inhale the solution for two minutes, when the hemorrhage ceased as if cut off short; but it had exhausted the remaining strength of the patient, who died two days after with suffocative phenomena.

*Autopsy.* Bloody serous exudation in the right pleural cavity floating the lung. In the right lung several insulated blood clots, of very dense consistence, and not bloody when cut into. In the left lung, similar blood-clots, but much smaller. The heart hypertrophied and covered with fat. Atheromatous deposit in the ascend-

ing aorta; insufficiency of the mitral valve. The left kidney much degenerated, the right one less so. Serous infiltration and effusion everywhere.

Dr. HOLM examined the blood clots, and found in all parts of the lung-structure iron in much larger quantities than could be attributed to the iron of the blood.

It is an important fact, that this very hemorrhage, which arose from great stagnation of the blood and regurgitation into the vessels of the lungs, was arrested by the inhalation of a watery spray containing chloride of iron, and that on the corpse could be demonstrated the deep penetration of the solution into the very bleeding tissue of the lung.

### *Phthisis Pulmonalis.*

FIEBER reports (*Lewin, op. cit.* p. 244) in detail a remarkable case of inferred phthisis in a married woman æt. 38, with exacerbating paroxysm of cough and vomiting every night about three o'clock A. M. Her general condition was improved by tonics—bark and quinine—but without any impression upon the severity of the cough, or the amount of the sputa. Narcotics and demulcents were of no avail. Then, abandoning all remedies except tr. cinchonæ, he instituted inhalations with the pulverisateur. Within twenty days the patient took, in all, 3635 inhalations (*inspirations*); the smallest number in any one day being 40, the largest, 300, the average, 240. This treatment began September 12, 1861, with 40 inhalations of the spray of pure water. September 14th, 80 inhalations, consuming five minutes, of a solution of tr. opii simplex gtt. iij ad aq. dest. f5j. The soothing effect being trifling, he increased the proportion to five drops, and on the 16th she took 80

inhalations, and the soothing effect was greater; 17th, 100 inhalations in five minutes; 18th, 5 grains of alum was added to prevent too great a degree of somnolence, which showed itself particularly towards evening; and of this, 75 inhalations in four and one-half minutes; 19th, 160 inhalations in ten minutes; 20th, 21st, 22d, each day 240 inhalations in fifteen minutes. Now she coughed very little during the day, and the expectoration had decreased. The nightly paroxysms of cough had lost nothing of their intensity. He then determined to make an experiment with an antiperiodic mixture, and on the 23d, the patient took 200 inspirations of a fluid containing to the ounce of water, 2 grs. quin. sulph. (of which 0.64 grs. dissolved, the rest remaining suspended) tr. opii gtt. vij, alumen gr. v. Nothing peculiar was noticed during the inhalation, but hæmoptysis occurred on that day, and also on the succeeding day, in all together to the amount of about four teaspoonfuls of blood, alkaline in reaction; and there was increase of the catarrhal symptoms. The patient complained of the benumbing sensation produced by the alum, and of its taste; and on the following day, September 25th, she took 120 inhalations, in seven and one-half minutes, of a mixture of 5 drops of tr. opii,  $7\frac{1}{2}$  grs. tannin, and one ounce of water. This solution was retained to the end of the treatment.\* The catarrh decreased; the sputa showed less blood. September 26th, no blood in sputa; catarrh trifling. The nightly paroxysm suspended for an hour, appeared at four A. M., and was less intense than heretofore. Patient complaining of weariness; no inhalation; 27th, 240 inhalations in fifteen minutes, paroxysm again at four A. M.; 28th and 29th, same treatment, paroxysm came on at five A. M., and for the

first time so modified that the patient did not vomit towards the last of it, as had been the case since June; on the 29th, the patient thought that she had overslept her paroxysm, but it came on, however, at six A. M.; 30th, no inhalation; paroxysm came on at seven A. M., and still weaker. October 1st, no paroxysm, 240 inhalations. Patient can now inhale without producing the least disposition to cough, which had always been the case, more or less, until this day. She has been sleepier than usual for several days, owing to the effect of the opium inhaled. October 2d, 250 inhalations; 3d, no inhalations; 4th, 5th, and 6th, each day 240 inhalations. At this point the treatment was discontinued, as there had been no paroxysm for several days, but little cough, and very trifling secretion. The percussion was the same as at the beginning of the treatment, but of the catarrhal râles, there remained only some rude respiration on the left side.

Another case from the same source. *Tuberculosis of left lung, hæmoptysis, intense cough, marked improvement under inhalations of opium and alum.* Patient, a man æt. 28, feeble, emaciated, tuberculous infiltration of left upper lobe, cough intense and painful, expectoration easy but very profuse, pulse 120. Treatment began May 10th, with inhalations of tr. opii fʒij, aq. dest. lbij, 20 inhalations in the morning and 10 in the evening, increased by the third day to 30 in the morning and 20 in the evening, with decrease in the frequency of the cough and in its intensity, decrease of moist râles, and reduction of pulse to 108. Now, alum ʒij was added to the opiate solution; expectoration decreased, strength increased. June 17th, 40 inhalations in the morning, 30 in the evening. July 1st, 50 in-



halations morning, 40 evening. July 2d, 50 inhalations morning and evening. Three grains of quinine were now added daily. Then the strength of the patient increased in a marked degree. After several nightly excesses, on July 9th a slight hæmoptysis, not followed by any injurious results. Early in August the catarrh was reduced to a minimum, and the patient returned to his own residence.

LEWIN (*op. cit.* p. 45) closes his own record of cases of phthisis treated by the new method of inhalation, with the following, in which the result promised a permanent cure.

*Tuberculosis Laryngis et Pulmonum.*—Judge K., of Bromberg, æt. 39, of slender build, feeble constitution, and phthisical diathesis, is the offspring of healthy, sturdy parents, still living. His mother, however, suffers from cough. He has three sisters, and they are healthy. Of the exanthemata, he has had only scarlet fever in his seventh year.

In 1841, after great exertion and exposure to cold, he contracted a “gastric nervous fever,” from which he recovered after a period of six weeks, but of which he soon had a relapse which lasted another six weeks. Since this time he has remained weak and feeble.

His present illness is attributed to an overheating followed by a cold, during an exhausting official sitting in 1855. The disease set in with chill, heat, fever, considerable cough, and subsequent emaciation. He then sought recuperation at Reinerz, where by the use of its tepid springs, with the use of whey, he became tolerably well again. While travelling, in the following year, 1856, the cough returned, and has since remained permanent without alteration.

In the summer of 1862 the patient sought the mineral springs at Ems, and not without some benefit; but fourteen days after the treatment at that place had been discontinued, there set in a hoarseness with occasional small, lumpy, bloody expectorations.

Soon after this he began to experience great difficulty in swallowing his food, so as to render the process very uncomfortable, and "he sate himself to his meals very reluctantly." The pain was felt principally during the first and third portions of the process of deglutition, and also by the passage of the bolus over the ulcerated epiglottis on one side, and the inflamed arytenoid cartilages on the other.

Present condition, June 2d, 1863: The pitch of the voice is high, attenuated, and weak. The soft palate is redder in color than is normal. On the right side are many relaxed veins extending as far as the uvula.

The circumvallate papillæ are much enlarged, and project in a button-like manner. On the right side of the root of the tongue is a thread-like vein with lateral varicosed branches, extending almost to the anterior attachment of the epiglottis.

The follicular glands are more swollen on the right side, less prominent on the left. Two very full glands, superficially ulcerated, are seen upon the glotto-epiglottic ligament.

On the anterior border of the epiglottis, particularly the left side extending beyond the middle line, is a loss of substance with tuberculous characteristics. The border of this defect of the epiglottis shows a small swelling on its free extremity where it approaches the sound portion of the left side, and, rather more upon the inferior surface, a button-like excrescence. The inferior sur-

face of the epiglottis in the neighborhood of this defect is yellowish and cicatrized, and the protuberance of the epiglottis can scarcely be seen.

The ary-epiglottic folds are more swollen on the right side, and there is a small cicatrix upon the left. The mucous membrane of the arytenoid cartilages is so œdematous from infiltration that it cuts off almost completely the view of the vocal cords, permitting only their anterior attachments to be seen, at which point their color is reddish livid.

The false vocal cords are dark red in color and very much swollen, and on the right one there is a superficial erosion.

The anterior wall of the trachea, as far as can be seen, is colored as from a recently contracted catarrh.

The larynx is painful to pressure. The neck is small, thin, and long. The contour of the thorax is flat, depressed, and paralytic. On the right side, beneath the attachment of the clavicle to the sternum, is a longish depression, and the whole region beneath the right clavicle is sunken in. Inspiratory elevation but slight. The panniculus adiposus gone.

Percussion in the right supra-clavicular region elicits a dull, empty sound; on the left side, normal. In the internal supra-clavicular region of both sides, the sound on percussion is alike and normal; externally, on the contrary, it is clearer upon the right side than on the left.

In the intrascapular region the sound on percussion is dull on the right side; otherwise everything is normal.

Cardiac dulness rather increased.

Auscultation reveals anteriorly in the left supra-clavicular region, undoubted sonorous râles in the apex

of the lung. On the right side, undetermined respiration. Vocal vibration and fremitus stronger over the right thorax than over the left.

Puerile respiratory murmur posteriorly, but much weaker on the right side than on the left.

The patient inhaled, during six weeks, at first common salt alone; later with the addition of the bicarbonate of soda, both in the same proportion, gradually increased to  $\mathfrak{zss}$ . to 24 oz. of water, to which at times a little tincture of opium was added. The beneficial effect was not temporary only, it was continuous; and to-day (reported in 1865) the patient still remains comparatively well, and pursues his laborious avocation in K——.

In this case the positively beneficial result was remarkable, for the tuberculous process in the lungs took on a retrograde movement.

I have had the opportunity of watching the effects of inhalations of nebulized solutions in a number of cases of phthisis, seven of which continued under my observation until their fatal termination. One of these was the most intimate friend I ever had. The inhalation of tar-water, of an infusion of wild cherry bark, of slightly narcotic solutions, afforded a great deal of relief to his cough and his dyspnœa; and when he left the city, about a year before his death, to try again the effects of a warmer climate, during a residence in which, from some ten years previous until shortly anterior to the commencement of the late war, he had been comparatively well,—that is, well enough to attend to business at all seasons,—he took his Siegle's apparatus with him, and from time to time employed it as he found it necessary to resort to its palliative influence.

In another case, that of a medical friend and former schoolmate, the relief to the dyspnœa from these inhalations was far greater than had been procured by any other method. This gentleman preferred the tincture of hyoscyamus, ten drops to the ounce of water, or of infusion of wild cherry bark, and often told me that the inhalation of half this quantity was sufficient to place him perceptibly under the narcotic influence of the hyoscyamus.

I have chiefly employed hyoscyamus and infusion of wild cherry, with an occasional astringent when the expectoration was profuse and exhausting; and tar-water as an antiseptic. The inhalation of warm water alone will facilitate expectoration. All of these cases experienced great relief from the topical effect of the inhalations. I have not had an opportunity of observing the constitutional effect of inhalations in the early stage of the tuberculous deposit, but since the report of Mr. Broadbent's success with the injection of acetic acid in cancerous and other tumors, I have been anxious to try its effect by inhalation upon tubercle.

Dr. J. R. WOLFE, of Aberdeen (*Med. Times and Gazette*, Nov. 25, 1865; *Brit. and For. Med. Chir. Rev.*, Oct. 1866, p. 538), writes: Prof. Longet lately made some experiments on himself with phenic (carbolic) acid for an attack of hæmoptysis and tuberculosis, and was so much relieved that the substance is now largely employed by several French physicians. Dr. Labort, of Vincennes, informed Dr. Wolfe that he had administered it to between two hundred and three hundred patients in different stages of phthisis with marked benefit. The mode of administration was the following: Fifteen drops of the pure acid were dissolved

in two ounces of spirit, and the solution mixed with thirty-two ounces of water, and this quantity was administered daily, partly by the stomach, and partly by the inhalation of the fluid in a pulverized state, by some of the instruments now in use for reducing fluids to fine molecules. It is remarked by Dr. Wolfe that as an adjunct to cod-liver oil, the phenic acid is beneficial in all stages of phthisis, but he considers it eminently useful in suppressing hemorrhage from the lungs, in allaying irritation, and arresting profuse secretion.

The inhalation of carbolic acid has been tried in the Pennsylvania Hospital, and in private practice by Dr. J. Forsyth Meigs, of this city, who finds it of value as a palliative in phthisis.

### *Pulmonary Gangrene.*

In relation to this affection Dr. BEIGEL states (*op. cit.* p. 190) that when he was physician to the Spa of Reinerz, he remembers some cases who had visited that resort in the hope of procuring relief from the fetid odor of their breath; and he relates the case of a young Russian, æt. 21, who had been subject to phthisis for years, and in both of whose lungs there were signs of large cavities. The breath of this patient was so fetid that he found great difficulty in securing apartments. He was made to inhale a solution of chloride of lime (one drachm to the ounce), which did not cause any cough; and though its effect was unmistakable, liquor chlori. (one part to six parts of water) was substituted, which made the patient's condition much more tolerable. He inhaled nearly every hour, and almost from the first inhalation, the improvement was so

marked that one could remain with him a quarter of an hour or more, which before had been impossible.

TROUSSEAU speaks of the value of tannin, extract of rhatany, sulphate of copper, corrosive sublimate, and arsenate of potassa in this affection when administered by inhalation, the doses at first to be very small, and increased gradually as the organism becomes accustomed to their influence (*Clinique Médicale de l'Hôtel Dieu*, Paris, 1861, p. 583).

### *Pulmonary Emphysema. Asthma.*

WISTINGHAUSEN (*Petersburger Med. Zeitschrift*, 1862, xvii, p. 137, quoted by Lewin, *op. cit.* p. 242) reports the following case cured by inhalations of Fowler's solution of arsenic. A young girl, æt. 15, whose mother had died of tuberculosis, had suffered from childhood with laryngeal and bronchial catarrh, eventuating in emphysema of both lungs with asthmatic paroxysms. After the employment of a great variety of remedies, external and internal; after a residence during three summers at Wielbach and Ems, at Salzbrunn; and the resort to local gymnastics during two winters—all without beneficial result—she was, at the suggestion of Prof. ECK, placed under the treatment by inhalation of solut. arsen. Fowleri gtt. x–xv–xx, pro aq. destil. f̄3j, once or twice a day. The same remedy had been administered inwardly without advantage, as had also  $\frac{1}{20}$  to  $\frac{1}{4}$  gr. of nitrate of silver, four times a day. After ten days of inhalation (ten minutes each day) the asthma ceased entirely, and, the inhalations being continued, did not return during the severe and cold winter and the variable spring of 1861. The patient could expose herself in all weathers without using the respirator,

with which until then she had been unable to dispense, even during a short promenade. She could also join in the dance until late at night without any trace of shortness of breath, though before this treatment, the very excitement of receiving an invitation to a company would bring on a severe attack of asthma. The auscultatory phenomena had not altered much, the mucous sibilant rales having subsided only in the right scapular region.

The patient had inhaled in all four ounces of the Fowler's solution, without any symptoms of arsenical poisoning. After this, she inhaled tannin, gr. x ad f5j, and after a time, ext. Turion. pini in the same strength, thirty drops at each time. Sales-Girons' apparatus was employed. Mathieu's instrument was employed once, but was uncomfortably cold.

LEWIN also recommends the use of Fowler's solution of arsenic, from half a scruple to half a drachm, to twelve ounces of water. He relates (*op. cit.*, 442-446) several cases in detail which he subjected to this treatment with benefit. Sometimes he added to the solution some common salt. He also, and occasionally with benefit, used the oleo-balsamic mixture, 5j to half the ounce of aqua castoreii.

WALDENBURG (*op. cit.*, 277-294) reports good results from solutions of common salt, tincture of opium, and oleum pini.

SIEGLE (*op. cit.*, p. 82) reports favorably on the effect of common salt.

LEIBLINGER recommends, in emphysema, the inhalation of the ol. terebinth, gtt. j to the fluid ounce of warm water, and also the ol. cadini, gtt. ij to the ounce.

I have seen a good deal of benefit from inhalations of



a weak solution of iodine, with and without combination of iodide of potassium, in a single instance of emphysema from chronic bronchitis, which has come under my own observation.

### *Syphilitic Ulcerations.*

Dr. JOHANN SCHNITZLER (*op. cit.*) reports two cases of syphilitic ulcerations of the naso-pharyngeal space, and of the larynx, very quickly cured by inhalations of a solution of corrosive sublimate, a grain to the ounce. The cleansing of the ulcerated surfaces could be demonstrated with the laryngoscope after each inhalation.

DEMARQUAY (*op. cit.* Lewin, p. 223) found rapid improvement in syphilitic affections of the soft palate, the pharynx, and the larynx, under the influence of nebulized solutions of corrosive sublimate, 25 centigrammes to 500 grammes of water, which he found the best of all topical remedies in connection with internal treatment. The inhalations were taken three to four times, and each time from five to six minutes in duration.

In several cases he saw very circumscribed mucous patches of these parts disappear rapidly. He remarked this particularly in an old man who suffered with great hoarseness, and on whose palatum molle there were such mucous patches. A general treatment previously instituted had afforded no relief, but he improved promptly under the new method.

### *The Sore Throats accompanying the Exanthemata.*

The management of the sore throat in cases of scarlatina and other exanthems, is often a matter of great difficulty, especially in young children, who cannot be coaxed into co-operation for the relief of the local symp-

toms. Where the patient is too young to gargle, or too feeble to do so, there is often great trouble experienced in making local applications by the mop or the syringe, to say nothing of the inefficiency of the method, and the effect of struggling on the constitution of the patient. With the nebulizer, especially if the duck-bill tubes are used, we have a means of making local applications at once agreeable and efficient, and can, therefore, to a certain extent, control the local inflammation. In one very bad case of *anginose scarlatina* in my own family, in which my friend Dr. Alfred Slocum of this city was called to my assistance, we had ample proof of the value of this treatment. The case was a very severe one in every particular, and considered dangerous from the very onset, and both physicians predicted an unfavorable termination. When the little fellow, a boy of seven years of age, could not by any means be induced to take a drop of medicine or nourishment, he never, after the first application of the nebulized spray, refused its repetition, but opened his little mouth, as far as the swelling would permit, to receive the grateful shower, and he often made motions asking for its use. It would have been impossible for this child to have gargled; he resisted with all his force, the application of a mop for the extraction of the profuse secretion from his swollen tonsils, and I firmly believe that but for the relief to the anginose symptoms, the patient would have died. We used the apparatus of Dr. Andrew Clarke. The case was the most threatening one I ever saw recover, and the patient was confined to his bed for six weeks, the disease being followed by nasal and aural catarrh, dropsy, intermittent action of the heart, long-continued swellings of the lymphatics of the neck, &c.

The material used in this instance was chiefly a solution of the permanganate of potassa, just strong enough to give the water a decidedly pink tinge; and occasionally, as the symptoms were more acute, a weak solution of alum water. These inhalations were administered hot, by placing the apparatus, for a few moments before using it, in a vessel containing hot water. When the patient called for the application at other times than when regularly ordered, the instructions were to employ hot water simply.

My friend, Dr. JAMES COLLINS, of this city, communicates the following case: *Scarlatina anginosa*. B—, æt. 6 years. Called January 25, 1867. After an infusion of capsicum and a saturated solution of chlorate of potassa had been used topically without apparent benefit, inhalations of creasote water gtt. vj to f3j, were begun on the third day of the disease, and administered at first every hour, and subsequently every second hour. The anginose symptoms were at once greatly relieved, and the child fell asleep breathing much better than she had done before.

The symptoms in this case were threatening from the beginning, and it terminated fatally on the sixth day.

There is no doubt as to the local benefit of the inhalations; they were evidently very soothing, and the patient was more comfortable from the time they were employed.

Supporting treatment was instituted, in conjunction with chlorate of potassa and tincture of belladonna.

Some observations on *the sore throat of small-pox*, and its extension as far as the trachea, have been made by NAUMANN and SEMELEDER, the symptoms of the ulceration being much those of severe catarrh. Astrin-

gent and narcotic inhalations had considerable influence in lessening the laryngeal complications (Baumgärtner *op. cit.*, p. 90).

In the *catarrh accompanying typhus fever*, RÜHLE observed favorable results from the antiseptic influence of inhalations of tannin (Baumgärtner, *op. cit.*, p. 91).

### *Pneumonia.*

But few observations have been made in the treatment of pneumonia by inhalation of nebulized fluids. Siegle remarks (*op. cit.* p. 85) that Auphan recommended the use of nebulized water at Euzet-les-Bains in hepatization of recent or of non-recent standing, though at the same time he considers inhalations contraindicated in coexisting inflammatory fever.

### *Diseases Other than those Affecting the Respiratory Organs.*

SALES-GIRONS has suggested (*Gazette Médicale*, September 8, 1866) the employment of nebulized solutions by inhalation in certain stages of *cholera*, where absorption having become impossible by the digestive tube, the lungs offer opportunity for the absorption of medicines into the system.

The same idea occurred to Dr. WITTMAYER, of Nordhausen (*Deutsche Klinik*, October 13, 1866), who proposes the inhalation of nebulized water to convey that fluid promptly to the thickened blood in the stage of asphyxia, and thus enable it to circulate more freely.

SALES-GIRONS (*Gazette Médicale*, Sept. 8, 1866) and ANCELON (*La Rev. Méd.*, vol. 4, p. 598) have employed inhalations of the sulphate of quinine successfully in the treatment of intermittent fever.

Anæmia, dyspepsia, and other affections, have been treated by the inhalation of nebulized fluids, with the view of affecting the system more promptly than by the usual method, especially in cases where the digestion has been impaired. The observations recorded are few and scattered, and, as yet, of too undecided value to justify a positive opinion as to their efficacy.

Quite recently, Sales-Girons has presented a memoir on respiratory therapeutics, upon which M. Bèclard has made a report to the Parisian Academy of Medicine (*Gazette Hebdomadaire*, No. 10, 1867). It is claimed that these inhalations may be safely resorted to in a great variety of diseases, for the purpose of producing constitutional effects, because the mucous membrane of the respiratory organs exceeds all other mucous membranes, including that of the small intestines as well as the stomach, in its powers of absorption, as a consequence of the rapid passage of the entire mass of the blood through the lungs, exposing, within the space of less than half a minute, almost every globule of that fluid to the action of any remedy, through the endosmotic action of an extremely attenuated membrane of great absorptive power. In proof of this capability of absorption, it is stated that twenty-five litres of water may be injected into the bronchi of a horse within six hours, and become at once absorbed without occasioning any sensible injury to the animal.

There may, therefore, be good grounds for Dr. Wittmeyer's idea of conveying water to the blood promptly in states of asphyxia, by means of its inhalation in the form of nebula.

In cases of infectious and contagious diseases, and under other circumstances where it is desirable to pre-

vent contamination of the atmosphere with the emanations from a patient or his discharges, or when it is desirable to disinfect an atmosphere already so tainted, we have a ready means of diffusing this purifying agent through the atmosphere of an apartment, by resorting to the process of nebulization, so as to divide it in the most minute manner possible. In this manner, one or more instruments can be placed in action in different portions of the room, and kept up sufficiently to maintain a comparatively pure atmosphere.

Upon this point, Dr. DA COSTA writes me: "Having had a good deal of facial erysipelas brought into the wards at the Pennsylvania Hospital, and two cases subsequently developing themselves there, I used chlorinated soda. In a few minutes the whole ward was filled with the odor of chlorine, and during the whole day and evening the particles of soda burn flickeringly in the lighter gas with their characteristic yellow flame, a good proof of diffusion. Surely, to disinfect rooms, &c., there is nothing better."

Then, also, in cases of disease where we wish to medicate the atmosphere with which the patient is surrounded, as with a terebinthinate or other impregnation, or simply to supply moisture, or to create an artificial sea-air, as was done in a more imperfect manner in 1845 by Hirzel, of Zurich, who sprinkled an artificial seawater from a small fountain, in the apartments of consumptive patients; we can place one or more instruments in convenient localities and keep up such a medication as is required, or renew it at proper intervals. So, too, in cases where patients are too feeble to make any effort at inhalation, and where it is impossible or imprudent to call their attention to the process, an in-

strument may be set going in close proximity to them, in such a manner that a portion of the air they inspire shall contain more or less of the nebula.

*Summary.*

In reviewing the entire subject, as portrayed in the preceding pages, we may conclude that the employment of remedies in this form is by no means to be ignored or underestimated, as far, at least, as regards diseases of the respiratory passages; that these inhalations are not to be used carelessly, for the reduction of tension in the air inhaled while loaded with nebula may induce congestion, which may prove detrimental, as in the case related by Fieber, in which hæmoptysis was induced, and in the case related by Trousseau, in which fatal pneumonia was induced by the too-frequent inhalation of an astringent; and as shown in the experiments of Demarquay upon rabbits, in whom the inhalations produced pleuro-pneumonia; that there is indubitable evidence of their great value in certain forms of sore throat, and particularly so in children; that they can be resorted to with confidence to restrain hemorrhage, to subdue irritation and inflammations, to relieve dyspnœa, to repress excessive secretion, to resolve exudation,—in fact, to do all for the respiratory mucous membrane that can be accomplished for other structures by the application of moisture, simple and medicated; that under favorable conditions of system, apart from constitutional implication, they are directly adequate to the cure of chronic affections of the respiratory organs that are at all curable; perhaps, in part, by inducing exercise of the parts as an essential element of the process, and thereby exciting restorative nutrition leading to resumption of

normal function ; but that they are not, in themselves and by themselves, adequate to the cure of disease, independent of general treatment ; that they are less applicable to acute affections than to chronic, except in so far as they palliate special symptoms or relieve them ; that they are less efficient than local applications by the mop or sponge, in cases of thickening, or ulceration, or other evident change of structure in parts within reach of the probang ; and that, therefore, though not specific in the usual sense of the term, they are to be regarded as an invaluable addition to our approved methods of administering remedial agents, and as such entitled to our favorable consideration.



# ON INHALATION.

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## PART II.

### THE INHALATION OF MEDICATED AIRS, GASES, AND VAPORS.

INHALATIONS of oxygen, nitrous oxide, sulphuretted hydrogen, and other gases, can be administered at ordinary temperatures; as also the vapors from chlorine, iodine, creasote, camphor, acetine, ether, chloroform, and, as highly recommended by Lewin, of muriate of ammonia in *statu nascente*. At an increase of temperature there can be employed in the same manner, the volatile ethereal oils, and the vapors from water and from decoctions of aromatic, resinous, and narcotic plants.

Vapors may be inhaled, diffused through the atmosphere of an apartment, or they may be conveyed directly to the respiratory organs by means of some of the apparatus to be employed.

The proper method of inhaling even gases and vapors from an inhaler must be acquired by the patient, otherwise the vapor will merely enter the mouth and reach the pharynx, or if it mixes with the air in the lungs, will do so by diffusion; but with some effort the manner of effecting penetration into the lungs can be readily

acquired. That it is no easy matter to inhale a vapor, and that consequently, when vapors of stramonium, &c., are smoked, instead of being carried into the lungs by the inspiratory current, they impress the system sympathetically or otherwise by their effect upon the mucous membrane or nervous distribution of the pharynx, can be made evident by attempting to inhale the smoke from an ordinary cigar. As usually smoked, none of the smoke passes the glottis, and when the attempt to inhale is made, it will be found to require considerable effort, and induce a paroxysm of cough with disagreeable sensations, even in the persons of inveterate smokers. A volume of smoke can be retained in the mouth without embarrassing respiration for a considerable time, which is proof positive that inhalation is being carried on behind the velum through the nares. Closing the nostrils the effect is different.

The importance, then, of seeing that patients inhale properly is self-evident, for if they are merely directed to inhale, in many instances the attempt will be futile, and the method of course fall into disrepute.

One great mistake often made is in having the water from which the vapor rises too hot. Usually a temperature of from 110° to 120° is all that will be requisite to disengage the vapor of vegetable substances, and the greater the volatility of the substance to be used the less the degree of heat that will be required.

Dr. JOHN HARWOOD, of London (*On the Practical Use of Inhalations, &c.*, London, 1839), endeavored by experiment to determine the best temperature for inhalation, as also the temperature of the water necessary to produce the desired temperature of inhalation. This he did by retaining the bulb of a delicate thermometer in

the vapor within the inhaler, and successively passing a volume of twenty cubic inches of atmospheric air at a given temperature through the instrument, this volume of air being similar to that which is received by the lungs during diminished or impaired respiration; and the passage of the current through the inhaler was conducted in the succession of the inspirations of breathing. It was thus ascertained that atmospheric air of  $57^{\circ}$ , when combined in its passage through the inhaler, with the vapor arising from

Water at $100^{\circ}$	afforded an inhalation of	$79^{\circ}$
" " $110^{\circ}$	" " " "	$84^{\circ}$
" " $120^{\circ}$	" " " "	$88^{\circ}$
" " $130^{\circ}$	" " " "	$93^{\circ}$
" " $140^{\circ}$	" " " "	$99^{\circ}$
" " $150^{\circ}$	" " " "	$104^{\circ}$

Dr. Harwood recommends water at from  $110^{\circ}$  to  $135^{\circ}$  as the best scale for ordinary purposes,  $130^{\circ}$  being the most suitable temperature.

### *Inhalers for Vapors, Airs, &c.*

MUDGE'S inhaler is a vessel with a tight cover, through which pass two tubes, one extending externally from the upper surface of the cover to within half an inch of the bottom of the vessel, the other extending from the lower surface of the cover some six or more inches. The external tube is furnished with a mouthpiece, through which inspiration is to be made, expiration being performed through the nostrils. The desired fluid being placed in the inhaler, inhalation is effected by drawing into the lungs through the external tube, the air contained in the inhaler over the surface of the fluid; the air is then resupplied from the atmosphere

by the inner tube, and passing through the medicinal fluid becomes impregnated with its active principle.

SIR CHARLES SCUDAMORE'S apparatus is substantially the same. He employed a glass vessel with a double neck; though a wide-mouthed bottle with two perforations through the closely-fitting cork will answer the same purpose. He directs that the water in the inhaler should be about an inch in depth, and to this the mixture to be inhaled must be added. He deems it important that the bottle should be large and the tubes capacious. The tube issuing from the bottle should be upright, passing gradually into a slight curve, so that the vapor should not be much cooled during its egress. The ingress tube should dip very near to the bottom of the vessel, that all the air introduced may become impregnated. The patient should be desired to inhale by a combination of a suction effort and a pretty deep inspiration; then to drop the under lip from the mouth-piece and make a free expiration, and thus continue the process, pausing occasionally to avoid fatigue, which would more certainly ensue by breathing quickly, or using an inhaler with small tubes, or containing too large a quantity of water.

Most of the inhalers in use are modifications of Mudge's. In using these, the tongue can be placed against the end of the tube in the mouth during expiration, so that the expired air passes out through the nostrils, or otherwise the mouth must be removed from the instrument at each expiration, in order that the expired air shall not pass into the inhaler. By using a mouthpiece provided with a valve, as in the admirable apparatus of Beigel, described and depicted further on,

in the section on the inhalation of oxygen, this inconvenience is avoided.

A different sort of inhaler was introduced by Prof. MAX LANGENBECK (*Deutsche Klinik*, 1861, p. 129), consisting of a flattened globe varying in diameter from three-quarters of an inch to an inch and a half, formed of two halves which screw together, after the medicated cotton, wool, or sponge has been placed in the interior ; a number of holes on each side permitting the passage of the air. The instrument is placed partially within the mouth, the lips of which compress the projecting portion.

An instrument virtually the same has been contrived by Dr. M. S. BUTTLES of New York (*Med. Record*, 1866, p. 44), to which a rubber tube may be attached, so that the instrument may be entirely concealed within the mouth, the tube remaining outside to permit access of atmospheric air. These instruments can be modified for insertion into the nasal passages in treating nasal, or naso-pharyngeal affections.

Dr. POMEROY of New York (*Med. Record*, 1866, p. 44), has modified this instrument, and Dr. A. P. MERRILL, of the same city, has recently devised a very elegant affair on the same principle, much of the shape of a lead pencil, designed especially for inhalations through the nostrils. An ordinary tobacco pipe answers the purpose fully. This method is adapted only for substances volatile at ordinary temperatures.

Dr. JOHN SNOW, of London, contrived an inhaler chiefly adapted for the inhalation of opium, but also applicable to many other medicines. It is made chiefly of tin, and consists of a cylindrical chamber, between four and five inches in diameter, and three or four inches deep,

under the centre of which a spirit-lamp is placed. The bottom of the inhaler consists of a thin piece of talc, on which is placed a small capsule of Berlin ware, for the purpose of holding the extract of opium. A porcelain funnel-holder, which is placed on the talc, keeps the capsule exactly over the flame of the lamp. The talc allows sufficient heat to be transmitted to the opium, without conducting it to the sides of the inhaler, and, consequently, the air which is inhaled is not unduly heated. The lid of the inhaler is movable, and it is provided with a delicately balanced valve for the admission of air, and is connected to a face-piece by means of an elastic tube of wide calibre. This face-piece covers the mouth and nostrils, and is a modification of that of Hawksley. It is flexible, the sides and margin consisting of thin sheet lead, lined with oiled silk and covered with leather, with an expiratory valve which can be moved more or less to one side from the opening it covers, so as to admit unmedicated air whenever the vapor feels too pungent.

### *Forced Inhalation of Atmospheric Air.*

We know of the benefits derived by residents in mountainous regions, and by the pedestrian tours and other gymnastic exercises to which pugilists are subjected during training, which, developing their respiratory capacity, increases their strength and powers of endurance.

In individuals with weak lungs, in those of sedentary habits, whose pulmonary organs are rarely properly aerated, the habitual employment of a number of forced inspirations of fresh air at stated hours, will soon exert a beneficial influence. The result will be facilitated by

forcibly straightening out the shoulders, either voluntarily or with the aid of an assistant, during the inspiration, which should be slow and through a small oval aperture, or through a quill, round which the lips are closed; and the position of the arms being maintained during the expiration.

*Forced Expiration and Inspiration for the Relief of Spasmodic Asthma.*

Dr. J. S. MONELL, of New York, writes to the editor of *The Medical Record* of that city (see No. for Aug. 15, 1866), that in December, 1865, about nine o'clock one evening, he was having a severe attack of asthma, to which he has been subject for fifteen years. He placed himself standing at the foot of his bed, with his arms folded upon the foot-board for a pillow, the forehead resting upon the folded arms, and the feet placed at a sufficient distance to make a partial semicircle of the body. While laboring severely for air, the thought occurred to him to cease breathing for a few seconds. He did so, and after several trials experienced some relief. He then expired all the air that it was possible for him to do, after which he determined not to inspire again until he found it absolutely necessary. He succeeded in waiting several seconds, then inspiration was carried to its fullest capacity, and retained with great effort for many seconds. This act of forced expiration, waiting, thorough inspiration, and again waiting, was continued for some fifteen minutes, and to his delight, the spasm was perfectly relieved. He has since relieved several similar attacks by the same method, in less than two minutes. He has advised this course for many others, and their testimony has been uniformly satis-

factory, except in one instance, that of an aged lady with heart disease. It requires a great effort on the part of the patient to perform this act. The first attempt at retaining the inspired air during the asthmatic attack, will cause the patient to think he cannot continue it, but perseverance will soon delight him with relief from the spasm.

*The Inhalation of Compressed Air.*

In the latter part of the last century, the attention of scientific men was directed to the influence of condensed air upon animal and vegetable life; and the result of certain experiments upon animals led to the suggestion that the respiration of compressed air might be beneficial in certain cases of disease.

E. TABARIE, Dec. 7th, 1832, made a communication upon the subject to the Académie des Sciences, and in August, 1835, M. Junod reported to the same body the result of his own experiments upon the human subject. Later, under the directions of M. Tabarie, the method was employed in the treatment of disease by Bertin of Montpellier, Pravaz, Milliet, of Lyons,—who reported some cases of phthisis apparently benefited in the first and second stages,—and others. Milliet's work, *De l'Air Comprimé comme agent Thérapeutique*, Lyons, 1854, contains (Lewin, *op. cit.*, p. 5, note) the record of twenty-two cases, including asthma, pulmonary congestion, emphysema, hepatization, phthisis, bronchial catarrh, chlorosis, whooping-cough, laryngo-tracheitis, broncho-tracheitis, bronchitis, and chronic pneumonia. Bertin's work, *Etude Clinique de l'emploi et des Effets du bain d'Air Comprimé dans le Traitement de Diverses Maladies*, Paris, 1855, contains (Lewin, *op. cit.*, p. 5,



note) thirty-five observations in bronchitis, acute and chronic, chronic angina with aphonia, chronic pharyngitis, aphonia, bronchial catarrh, pulmonary œdema, emphysema, asthma, hæmoptysis, chronic pneumonia, and phthisis.

SANDAHL (*Om Verkniningarne of fortätad Luft, Stockholm*, 1862; see Lewin, *op. cit.*, p. 6, note) reports the statistical observations of three hundred and fifty-three cases, of which there were one hundred and forty of diseases of the larynx and trachea, seven of pneumonia, twenty-two of asthma with emphysema, thirty-one of tuberculosis, five of organic valvular insufficiency of the heart, ten of anæmia, and thirty-five of aural catarrh.

Tabarie's apparatus consisted of a wrought iron spherical chamber, capable of accommodating from one to a dozen patients; air under a pressure of from  $\frac{1}{2}$  to  $\frac{2}{3}$  atmosphere, was forced into the chamber by a pump worked by steam. An arrangement attached to the apparatus afforded egress to the air expired by the patients. Each sitting lasted two hours, the requisite pressure was produced gradually during the first half hour, and after being continued for an hour, was gradually withdrawn during the last half hour.

### *Inhalation of Oxygen Gas.*

Dr. BRICHETEAU (*Bulletin Générale de Therapeutique* Feb. 25, 1866; also, *Brit. and For. Med. Chir. Rev.*, Oct. 1866, p. 532) relates some of his experience with the inhalation of oxygen gas. He uses an India-rubber bag furnished with a mouth-piece, which is controlled by a stop-cock; and the patient taking a deep breath out of the bag, the quantity of the gas inhaled may be approximative gauged by the extent to which the bag

collapses at each inspiration. This apparatus must be similar to the one so much in vogue by the dentists of this country for the administration of the nitrous oxide gas for anæsthetic purposes. To prevent the air of expiration from entering the bag, and thus mingling with the pure gas and diluting it with its products, it is directed that the patient close his lips, and pass the expiratory current through his nostrils; or what is to be preferred, the India-rubber tubing may be compressed near the mouth-piece during the process of expiration.

M. Brichetau considers inhalations of oxygen adapted to phthisical cases only under special conditions, admitting that in diseases attended with the febrile movement, it may even act injuriously; but that its employment may be of service in the earlier stages of phthisis in patients of scrofulous or lymphatic habit, where the local symptoms are not well marked, and where there is progressive emaciation with persistent dyspepsia, a condition looked upon as favorable to the formation of pulmonary tubercles.

Oxygen has also produced amelioration of the symptoms in some cases of asthma. Its value in anæmia is incontestable.

M. DEMARQUAY (*Gazette Médicale de Paris*, April 14, 1866), who has devoted much attention to the use of oxygen inhalations in medicine, says, in speaking of its therapeutic indications, that in the early stages of phthisis, when there is no fever, and no fear of exciting local action, when the patient is becoming emaciated, and the emaciation is increased by persistent dyspepsia, oxygen may have a salutary influence in modifying the state of constitution, and sustaining the organism. Asthenia is the disease in which oxygen has been given

by preference. Of twenty-two patients treated by Beddoes, ten were cured, and nine relieved. But the employment of oxygen in asthenia meets with numerous contraindications. Oxygen renders indisputable service in essential anæmia. It is specially indicated in that form of chlorosis of young girls which is characterized by obstinate anorexia; in the anæmia of convalescence, and in the anæmia, often severe, of newly-delivered females. The inhalation of oxygen is also successful in anæmia arising from hemorrhage or from fatigue, and is also a very energetic remedy in the debility produced by prolonged suppuration; it stimulates the appetite, sustains the powers of the patient, and enables him to recover. In diabetes, under the influence of oxygen inhalations, the quantity of sugar contained in the urine is remarkably diminished.

In surgery, oxygen stimulates weak and ill-conditioned ulcers, and accelerates the production of granulations in cicatrizing wounds. In senile gangrene, as long as the circulation continues in the artery of the foot, oxygen is, according to the observations of MM. Laugier, Demarquay, and Maurice Raymond, the only remedy which, in advanced cases, affords a chance of recovery. (*Ranking's Abstract*, Jan. 1867, p. 200.)

According to Demarquay's observations, oxygen when respired to the extent of twenty-nine or thirty quarts, produces little effect. Various invalids derived benefit from such a dose repeated daily. They observed sometimes, a little heat in the pharynx, and a little confusion in the head, or headache; the pulse usually rose a little in frequency and force, but sometimes fell; the appetite improved, and there was a general sense of comfort and of increased energy. It does not appear to

be suited to those greatly exhausted by suppurating wounds, nor those in the later stages of phthisis.

I reproduce in this place, an interesting chapter on this subject from BEIGEL (*On Inhalation as a Means of Local Treatment of the Organs of Respiration by Atomized Fluids and Gases*. By Hermann Beigel, M.D., L.R.C.P.S., &c., London, 1866, p. 69).

“Their efficacy can be explained if applied to the proper cases. In all diseases in which dyspnœa forms one of the most dangerous consequences, no doubt can exist of the manner in which oxygen acts, as in diseases of the heart, for instance, in bronchitis, in asthma, emphysema, and more especially in phthisis. Here a part or parts of the lungs are impermeable to the air. But the body requires a certain amount of oxygen (an adult about 23,000 cubic centimetres, or 34 grammes, per hour) for the purpose of decarbonization of the blood, without which its existence is either impossible or very much disturbed. The diseased lungs are, therefore, forced to counterbalance by the number of respirations what, in a healthy state, they would have done by the greater capacity of the same. Hence, respiration in individuals laboring from a disease which impairs healthy breathing, becomes irregular, difficult, frequent, which frequency in lung diseases is in close relationship to the area of the lungs that became impermeable. Now if we assist the lungs in their unnatural labor, by giving them either pure oxygen, or such an atmosphere as contains a greater amount of that gas than usual, or, in other words, if we assist the decarbonization of the blood in a manner which does not force the lungs to perform such an exhausting exercise, we place the patient in the best possible position. In diseases of the

heart the same takes place, with the difference that imperfect circulation of the blood is the cause of its being insufficiently decarbonized.

“After Priestley had detected oxygen, and Beddoes and Davy had begun to treat patients by means of that gas, the fate of oxygen was the same as it is of all medicaments which were considered to possess such properties as to cure almost every disease. Medicaments of that kind do not exist and cannot exist, and disappointment has always been the result of such assumptions; but then the fault is generally made in the other extreme direction, namely: the conclusion is then drawn, that because the respective medicament did not cure *all* diseases, it does not possess healing properties at all.

“Neither of those ways is the path science studies, separately and minutely examining every action and property of a body, accepting that which is found to be useful, and rejecting that which has proved useless.

“From this point of view we must admit that inhalations of oxygen, pure or mixed with air, are an agent highly valuable in diseases, in which imperfect decarbonization of the blood takes place,—be it by impermeability of some parts of the lungs, be it by imperfect circulation of the blood, by closure of the glottis, by admixture of poisonous substances to the blood, or other causes.

“It is not long since the application of compressed air in certain diseases of the chest has been recommended, and Berton, Junod, Tabarié, and Pravaz have endeavored to show it to be the most effective remedy in such affections. Now, Dr. Lange has gathered all facts hitherto known in connection with the subject, and maintains that the efficacy of the compressed air principally rests

upon the blood being more richly supplied with oxygen, and that a healthier nutrition is the immediate consequence of it. He proves that by the application of compressed air, a considerable increase of the negative pressure of inspiration and of the positive pressure of expiration takes place, whereby the power of the muscles of inspiration becomes greater, the pressure of the blood in the aortic system is lowered, and the frequency of the heart's pulsation diminished. The animal heat lowers likewise after the application of a compressed air bath, the organs of digestion are placed in a better position, whilst the appetite increases, and the functions of the bowels are performed with greater ease. Increase in secretion of the urine has been observed in most of the cases.

“It has generally been thought that pure oxygen cannot be inhaled without injury to health; but Demarquay and Leconte have shown that they, as well as their friends, could readily inhale from twenty to thirty litres\* without suffering any injury, and Ducroy has stated in the Academy of Paris, that pure oxygen, contrary to the general belief, can be inhaled for several hours without being detrimental to health; that its action is antagonistic to that of chloroform; that it is a powerful remedy for the disagreeable accidents arising from chloroform and other anæsthetics; and that in asphyxia from poisonous gases—as, for instance, from carbonic acid—it exercises likewise a beneficial influence. Ducroy, therefore, proposed to make every patient, awakening from a chloroform-narcosis, inhale oxygen, in order to rid him of headache and other inconveniences following the ad-

\* A litre is 1.0567 quarts.

ministration of that anæsthetic. According to the reports of different authors, it should be a rule, whenever chloroform is administered to have the oxygen-inhaler ready for use.

“In compliance with the foregoing remarks, Mr. Erichsen, in his ‘*Monograph on Asphyxia*,’ says : ‘In a considerable number of experiments that I have performed on this subject, I have never succeeded in re-exciting the contractions of the ventricles by means of the inflation of the lungs with common air, provided they had fairly ceased to act before artificial respiration was set up.’ He was then led to try oxygen, and in several instances was successful in restoring the action of the ventricles after the entire cessation of the heart’s action.

“Most interesting are the experiments made by Beddoes, whereby it was clearly shown that animals drowned and kept in water till death had apparently occurred, soon recovered in the free air, when, previous to their being drowned, they had inhaled oxygen ; while others which had not, died. The same result was obtained with animals put into mixtures which produce a very low temperature. Those which had previously inhaled oxygen could for a long time remain in such mixtures, whilst others were frozen to death ; others, again, were exposed to an atmosphere of hydrogen, and kept therein until entire cessation of respiration. Those treated previously by oxygen soon recovered when brought into the air, whilst animation could not be restored in the others.

“But to return to our theme, viz., the application of oxygen, it has proved to be of great value in cases in which insufficient oxidation, or an abnormal composition of the blood, forms a prominent symptom ; as in asthma,

in the more advanced stages of consumption, in chronic bronchitis, anæmia, Bright's disease, chlorosis, and other similar affections. Inflammatory stages of phthisis, inflammatory conditions of the respiratory organs in general, contraindicate the application of oxygen. It need not be mentioned that an alternately-combined treatment of oxygen and atomized fluids sometimes will render better services than either of them exclusively applied, as will be seen in many cases to be reported on in the second part of this treatise.

“It remains now for me to make a few remarks on the apparatus I use for the administration of oxygen gas, as well as for the inhalation of volatiles, &c. It differs from the inhalers hitherto constructed, not only in shape and finish, forming a fine ornamental vase, but tends also to remedy some inconveniences connected with other similar apparatus. The patient was hitherto, after each inspiration, either obliged to turn his face from the apparatus, in order to perform the expiration, or to expire into the apparatus, whereby the oxygen became mixed with the expired air.

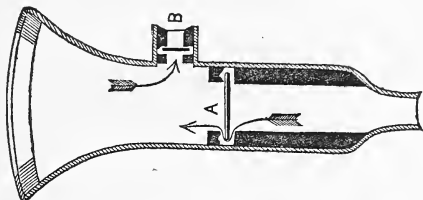
“The only apparatus which tried to avoid this inconvenience is that of Dr. Richardson. But the mouth-piece of his apparatus, covering very inconveniently the patient's mouth and nose, is not only rather clumsy, but the valves which were intended to regulate the inspiration and expiration, soon became rolled up and never acted, or in a very insufficient manner only.

“The following section of the mouthpiece of my inhaler (Fig. 11) sufficiently explains its construction. The two valves (A and B) are made of vulcanite, and, acting extremely easily, close and open with great precision. It is obvious that the inhalation of the oxygen with each



inspiration—during which the valve B gets closed—takes place in the direction of the arrow at A; while,

Fig. 11.



during expiration, A closes, and the expired air escapes in the direction of the arrow at B.

“In respect to the production of oxygen gas, it is now quite cheap enough as to be used by almost every patient. Hitherto, Messrs. Robbins & Co.’s oxygenesis has been frequently used. But though a quantity of the gas could readily be obtained by it in a short period, two things prevented the preparation from being generally applied, namely: its price, and the necessity of placing into the patient’s hand a quantity of sulphuric acid. But these impediments do no longer exist, since Messrs. Robbins & Co., recently manufacture another preparation, which is distinguished by its cheapness and by the large amount of oxygen which can be produced by it, as well as by the great ease and simplicity with which the evolution of the gas can be carried on by the patient, it being only necessary to put the powder into the inhaler and to pour hot water over it; the gas then immediately escapes, and can be inhaled through the mouth-piece. Thus no obstacle to the general application of oxygen in appropriate cases any longer exists.”

Early last year I procured from London one of Dr.

Beigel's inhalers and a quantity of Robbins & Co.'s oxygenerator, as the powder furnished by them is called. Inasmuch as its importation into this country makes it rather expensive, I requested the importers to ask for the formula for its manufacture, but this courtesy was refused by the manufacturers. I think it is composed of chloride of lime, with a small quantity of the peroxide of cobalt, the reaction upon the application of heat being the same as that of nitric acid in the formation of sulphuric acid. I have seen it mentioned somewhere, that a solution of the chloride of lime, with a trace of the recently-prepared peroxide of any metal, will give off oxygen upon the application of heat, leaving, after the reaction, nothing but chloride of calcium and water. A portion of this powder was examined by Prof. R. E. Rogers and Prof. Rand, of this city, who confirmed the statement of Dr. Beigel as to the prompt evolution of oxygen gas, and my supposition as to the constituents of the powder. The amount of gas given off is about equal in volume to that procured from chlorate of potassa by the ordinary method of heating in a retort. Drs. Barton and Leffinan, chemical assistants in Jefferson College Laboratory, examined a specimen of this powder, and found it to contain oxide of cobalt in small quantities, and unequally distributed throughout the mass.

It would certainly be desirable if some enterprising chemists would manufacture the compound in this country, so that it would be cheap enough to come into general use. Oxygen inhalations could then be resorted to as readily as inhalation of any of the volatile articles of the materia medica, the evolution of the gas ensuing immediately upon the addition of boiling water.

A rough method of impregnating the atmosphere with oxygen gas extemporaneously, is to throw some chlorate of potassa upon live coals; but of course this method is much inferior to one by which the gas can be collected.

My own experience with oxygen gas as a therapeutic agent has been thus far exceedingly limited. I have employed it in a number of cases of imperfect aeration of the air-cells of the lungs from deficient inspiration, and with decided benefit, but I am not prepared to state the benefit was not entirely due,—as it was in great measure due, certainly,—to the mechanical effect of the inhalation expanding the air-cells by forced inspiration, for in the fine weather of spring and summer I have seen results fully as satisfactory from regular deep inspirations of fresh air; the patient seated in the open atmosphere, or before an open window, and taking deep inspirations slowly, while an attendant forces the shoulders backwards so as to assist the expansion of the chest during the effort of inspiration. From four to eight such efforts are sufficient at a time to begin with, and may be repeated twice a day. In cases where there is a sense of oppression in the upper portions of the chest from inefficient expansion, the relief given by these movements is prompt and decisive.

I feel free to record that in one case of undoubted incipient phthisis, by which I mean a case of impaired respiration, in which the general symptoms and the family history strongly pointed to the onset of pulmonary tuberculosis, but in which there were as yet no positive physical signs of the disease other than impaired respiration, and extreme dyspnœa at the first institution of the mechanical exercises above mentioned, the inhalation of oxygen gas, has certainly, for a time

at any rate, warded off the threatened disease, and given the patient renewed vigor, as evinced by increase in nutrition, renewal of vital buoyancy, and restored powers of physical endurance. Of course, it is impossible to say determinately that this case would have been one of phthisis, for when any threatened disease is early arrested, or aborted, the pathological evidences of correct diagnosis are lost.

The inhalation of oxygen has been tried in Europe for *scarlet fever*, but I am unable to do more than mention the fact.

Dr. WITTMAYER, of Nordhäusen (*Deutsche Klinik*, Oct. 13, 1866, p. 366), has suggested the inhalation of oxygen, and of the vapor of water *in the stage of asphyxia in cholera*. He is led to the employment of these inhalations because the functional activity and absorbent powers of the alimentary canal being impaired, and hypodermic injection having failed, there remains open to us but the respiratory tract by which to convey remedies to the system at large. He considers two indications highly important in this stage of cholera; the first being to convey water to the thickened blood; for which purpose he proposes that the patient shall inhale steam and hot water nebulized from one of Siegle's apparatus, the temperature of the nebulized water being kept sufficiently warm by a flame under the medicine-glass; then, he contends that as the thickening of the blood impedes the interchange of the gases in the lungs, the second indication is to convey oxygen to the blood, which is best accomplished by inhalation of the pure gas, which he maintains would have a more promptly excitant action upon the heart than any ordinary medicine which could be adminis-

tered in another method; and as a result, the blood would be enabled to circulate through the vessels more rapidly, and become better and better prepared to imbibe the desired amount of vapor of water and of oxygen.

Dr. JÜTTE, of Stettin (*Deutsche Klinik*, Dec. 1st, 1866, p. 436), commenting on the article of Dr. Wittmeyer, says that he had made the experiment of administering oxygen by inhalation to four adult patients during the short and severe epidemic which prevailed in and about Stettin in the year 1856; and that the administration had been conducted with great care, and with sufficient frequency; but that all of his patients died without evincing the least sign of even temporary improvement, and he was so disappointed with the result that he did not pursue the experiment any further.

This idea of Dr. Wittmeyer is, however, not entirely new, at least as far as regards oxygen inhalations in cholera, though, as far as I know, the suggestion of the inhalation of the vapor of water under such circumstances, is entirely original.

In the "Reports on Asiatic Cholera in the Madras Army, from 1828 to 1844, by Samuel Rogers. London, 1848," the inhalation of oxygen is spoken of favorably.

*The inhalation of Oxygen as an antidote in narcosis* has received recommendation from other sources than those already mentioned incidentally.

Thus (*Ranking's Abstract*, vol. 5, 1847, p. 332), under the impression that the specific effects of ether vapor upon the system are due to its power of producing a state analagous to asphyxia, it has been suggested by Dr. Jackson, and subsequently by Mr. Richardson, that oxygen should be kept ready to be inhaled in case of the occurrence of formidable symptoms, and Mr. Hooper,

acting on the suggestion, has supplied his inhaler with the means of furnishing oxygen at pleasure.

The following case is related (*Ranking's Abstract*, vol. 17, p. 118, from the *Canada Medical Journal*, Jan. 1853) in support of the idea that the inhalation of oxygen might be very beneficial in the asphyxia caused by chloroform and carbonic acid, or by drowning. "A young man attached to the laboratory of the New York Medical College," writes the late Dr. SIMEON ABRAHAM, "became asphyxiated from the inhalation of the vapor of chloroform; and so far had its effects been carried, that he became pulseless, and all hopes of his resuscitation abandoned; and as all the usually recommended remedies had been tried without success, nothing but the death of the young man was looked for, when I proposed, as a *dernier ressort*, the application of pure oxygen gas as the only chance by which resuscitation could be brought about; but, at the time, the proposal met with opposition from the medical men present, who were anxiously watching what seemed to be the expiring efforts of the poor boy, expecting each moment to be his last. Having, however, consented, the gas had not been more than a few seconds applied to his nostrils, when he who was apparently beyond the help of human aid, and absolutely *in articulo mortis*, arose and placed himself upon a chair, proving most conclusively how correct I was in proposing the application of oxygen gas as a remedy against the deleterious effects of chloroform as an anæsthetic."

Dr. BEIGEL (*op. cit.*, p. 104) considers the administration of oxygen gas particularly applicable to the suffocative paroxysms of *croup*, not for the purpose of curing the disease by the inhalation of oxygen, but to

guard the patient from the consequences of such attacks, which frequently prove fatal, and to place him in such a position as to enable us to apply other remedies; oxygen, under such circumstances, having in some measure the same effect as tracheotomy, whereby we intend to evade a particular part of the respiratory tract, in order to gain time till we possibly master the inflammation, as well as the formation of the pathological products represented by the croupal membranes.

As an illustration of this fact, Dr. Beigel reproduces (p. 105) the following case, reported by Miquel (*Correspondence Blatt des Vereins für Gemeinschaftliche Arbeiter*, 1862):

*“Severe case of croup; application of the usual medicaments without benefit. Immediate alleviation after oxygen had been inhaled.—*The patient was a boy twenty-one months old, hitherto perfectly healthy. On February 21, 1862, Miquel was summoned, and found the child in the following condition: Breathing, noisy and whistling, short, some fifty respirations in the minute, but irregular, as well in respect to the rhythm as to duration; pulse small, very frequent, impossible to be counted; countenance pale, lips livid; all muscles are active during breathing, and the regular movements of the levatores alæ nasi, of the muscles of the throat, &c., were combined with irregular spasmodic movements, which now and then agitated the face. The little patient frequently bent his head quite backwards, the expression of his countenance being very anxious, and seized his throat convulsively with his hands. His face was moist and cold. The child very seldom yet made efforts to cough; when coughing, the voice appeared barking, hoarse, sup-

pressed. According to the report of the house doctor, nine days ago the child was seized with symptoms of croup, which at first decreased by emetics, leeches, and other remedies, but three days ago have recurred with great intensity. The usual remedies were applied again, but failed to do any good, and a newly administered emetic was to the same effect; involution of the legs in mustard powder, and inhalations of hot steam, were vainly resorted to. At half-past ten, inhalations of oxygen were tried. One cubic foot of that gas, one volume of pure oxygen mixed with a smaller portion of atmospheric air in a gasometer, was brought to the patient's residence. The amount of respiration might have been about five cubic inches, the quantity of gas (1728 cubic inches) was, therefore, sufficient for 350 inspirations, which might have been performed in about nine or ten minutes, yet the procedure lasted about fifteen to twenty minutes. The child's condition after the inhalation was the following: pulse perceptible, less frequent, number of respirations about the same. The appearance of the child was, according to the judgment of all persons around him, more quiet, less anxious; patient became more reactive to the impediment to respiration, so that he coughs frequently, though with the peculiar croup sound; once such a cough spontaneously produced vomiting. The spasmodic movements of the muscles of the face, as well as of other regions of the body, ceased, and at one o'clock in the morning the parents came to me to report that the child had slept very quietly, and that the spasm and anxiety had disappeared. They added that on no previous night the suffocating seizures and the expression of the countenance were so alarming; but that on none of the four



previous nights was the patient so quiet as he is to-night. On the following morning the child was found to be still better, and though the oppression recurred on the following evening in a slight degree, yet all the remainder vanished by medicaments applied for the disease itself, and the patient recovered entirely."

BEIGEL relates the details of several cases under his own care, treated by alternate inhalations of oxygen and of nebulized fluids.

One of these (*op. cit.*, p. 114) was advanced diphtheria in a child six years of age, which was cured by the inhalation of oxygen gas, one gallon morning and evening, and the inhalation of a solution of the tincture of the chloride of iron, ten minims to the fluid ounce of water; a remarkable alteration in the patient's condition being perceptible after the first inhalation of oxygen. Also (*op. cit.*, p. 116) a very severe case of diphtheria after small-pox, with exudation lining the whole pharynx, laryngeal implication, suffocative paroxysms, &c. The patient, a boy ten years of age, was seen by Dr. Beigel on the fourteenth day of the illness, after the administration of calomel for six days had afforded no relief. This case was treated by inhalations of the spray of hot water, afterwards of lime-water, and subsequently of tannin; oxygen being administered to relieve the suffocative attack with complete success, and being continued twice a day as long as requisite; the combined treatment resulting in a cure.

It will be remembered that in Lewin's fourteenth case of diphtheria (see p. 131), oxygen inhalations were resorted to in addition to the other treatment.

Beigel also relates (*op. cit.*, p. 133) a severe case of asthma, in which the suffocating attacks were sup-

pressed by inhalations of oxygen ; this case and several others, detailed in succession, having been cured by the alternate inhalations of oxygen and of Fowler's solution of arsenic. He also details a case of emphysema, and one of chronic laryngitis with suffocative paroxysms, in which oxygen inhalations were productive of great benefit.

Beigel believes that in children predisposed to phthisis, the inhalation of oxygen gas would delay, or even prevent the outbreak of the disease ; and that even after the development of the affection, inhalations of oxygen gas sometimes render astonishing services. In proof of this he details a case (*op. cit.*, p. 182) in which an engineer, twenty-three years of age, of scrofulous diathesis, with tuberculous infiltration of the left apex, and bronchial catarrh of the right lung, with hæmoptysis, colliquative perspirations and rapid loss of flesh, was so much improved by the inhalation of a gallon of oxygen twice a day, and of a solution of the sesquichloride of iron twice a day, that in a little less than five months, at which time the treatment was discontinued, the patient could hardly be recognized as the same man ; he had grown strong and muscular, and but that dulness remained at the left apex, he could be considered perfectly healthy. He was seen a year afterwards by Dr. Beigel, whom he assured that he had enjoyed very good health during the whole of that period.

#### *Inhalation of Nitrous-Oxide Gas.*

The inhalation of nitrous-oxide (laughing-gas) has been employed pure, for the purpose of supplying the system with a large amount of the oxygen it contains, and in the same affections for which oxygen has been

recommended, such as anæmia, incipient phthisis, &c.; and, it appears, equally applicably. It is now prepared extensively in all our large cities as an anæsthetic for dental purposes, and can thus be readily procured by those who wish to try its efficacy.

Surgeon GEORGE G. SHUMMAN, United States Volunteers, reports (*Am. Med. Times*, 1863, pp. 28 and 38) a number of cases (14) of typhoid fever, also two of measles, and one of erysipelas, in which inhalations of the nitrous-oxide gas were administered at the stage of prostration for the purpose of supplying oxygen to the system, with beneficial results in all cases; even in some which proved fatal, for life had been apparently prolonged many hours by this means, although insufficient to stimulate to the point of recûperation. Some of these cases which recovered, had been pronounced hopeless, and all of the patients are reported as having expressed themselves as feeling much the better for the inhalations. Attention is called to the resort to this method in the prostrated stages of cholera and other affections.

Whether it acts by supplying oxygen is a question. Other compounds of oxygen and nitrogen containing a much larger proportion of oxygen, are, as is well known, extremely deleterious when inhaled. It is quite probable that the nitrous oxide has an influence as such; because we know that the action of chemical compounds is often different to what would be inferred from a knowledge of the effects of their constituents.

#### *Inhalation of Vapors of Chlorine.*

Chlorine may be inhaled by adding water to chloride of lime in a Wolfe's bottle or other inhaler.

It has been asserted that paper-makers, though ex-

posed to the fine dust from the rags, &c., are, as a class, peculiarly exempt from phthisis, and on account of their exposure to the fumes of chlorine; and it is probable that this circumstance gave origin to its suggestion as a remedial agent by inhalation.

GANNAL, observing that workmen in a bleaching establishment, who suffered under diseases of the chest, were visibly improved, ascribed the amelioration to the inhalation of air containing this gas, and was led to institute experiments upon consumptives, with good results. Sir JAMES MURRAY is reported (*Dub. Jour. Med. Sci.*, March, 1839), to state that a friend had observed similar beneficial effects among his workmen from exposure to the inhalation of a watery vapor strongly impregnated with this gas.

LOUIS reported that in a number of experiments on consumptive patients at La Pitié, L'Hôtel Dieu, &c., he had not obtained any successful result from the inhalations of chlorine gas; though he has elsewhere admitted, with M. Cottureau, that singular advantage may be obtained from chloruretted inhalations in certain cases of chronic bronchitis, even where the general symptoms closely resemble those of phthisis.

Dr. STOKES found these inhalations prejudicial in phthisis, being too provocative of irritation, though he found them beneficial in correcting fetor in gangrene of the lungs. Dr. Elliotson found them secure greater amelioration than narcotics or any other means then employed; and many others have confirmed this result.

Dr. A. T. THOMPSON considered chlorine (*Dunghison's New Remedies*, 7th edit., p. 200) the best topical expectorant, and the most salutary excitant to the mucous membrane that had yet been inhaled.

Sir CHAS. SCUDAMORE tried chlorine in several instances of phthisis, but found it inferior to iodine.

Dr. ELLIOTSON (*Lancet*, 1830-1, vol. 11, p. 198) found great mitigation from inhalation of chlorine in two cases of phthisis.

"A remarkable case of consumption, of the worst kind, cured by inhalation of chlorine," is reported by Dr. COTTEREAU (*Lancet*, 1830-31, vol. 11, p. 169, from the *Journal Hebdomadaire*), in which, some two years after being cured of his consumption, the patient died from acute inflammation of the mucous membrane of the stomach and small intestines, without any derangement of the respiratory system; and the post-mortem examination showed the old cicatrices, and some crude tuberculous granulations. Twelve more cases, in which all the physical signs were decisive of phthisis, and in which recovery ensued under inhalations of chlorine, are recorded by Dr. Cottereau in *Arch. Gén. de Méd.*, November, 1830.

In cases of poisoning by hydrocyanic acid, as well as by sulphuretted hydrogen, the inhalation of chlorine is a most efficient agent. Chlorinated lime may be used for this purpose. (*Dunclison's New Remedies*, 7th ed., p. 202.)

Prof. DUNGLISON considers the inhalation of chlorine adapted only to cases of disease in which the pathological condition of the bronchial mucous membrane or neighboring parts, requires the exhibition of an excitant. In this way it may be occasionally serviceable in chronic bronchitis. (*Materia Medica*, 4th ed., p. 257.)

The gas, in proper dilution for inhalation, may be evolved by mixing one or two drachms of the chlorine-water with a couple of ounces of hot water, and placing the vessel in a hot bath, or over a flame.

Dr. CORRIGAN (*Dunghlison's New Remedies*, 7th ed., p. 201, with figure) devised an apparatus for this purpose, fulfilling the following requisites: *Firstly*, That the apparatus should be simple in its construction and easily kept in order; *Secondly*, That it should be capable of keeping up a supply of vapor for any length of time, and that the evolution of the vapor should be steady and easily regulated; *Thirdly*, that it should also furnish a sufficient supply of aqueous vapor, to prevent any irritation of the larynx, or lining membrane of the air-tubes; and, *Fourthly*, and most important of all, that its employment should entail neither trouble nor fatigue on the invalid. This apparatus consists of a light, open, iron-wire frame, about eighteen inches high, at the bottom of which is a spirit-lamp; at the proper height above this is an evaporating porcelain dish, about six inches in diameter; and above this is a glass globe, with its neck downwards. In the neck of the globe is a cork, bored, and through the opening is drawn, moderately tight, a short plug of cotton wick, such as is used in a spirit-lamp; in the glass globe, opposite the neck, a pin-hole is drilled, to allow air to pass in, according as the fluid within drops out through the neck. To use it, the porcelain dish is filled with hot water, the spirit-lamp is lighted, and as soon as the water in the dish has begun to boil, the glass globe containing chlorinated lime (if this be the substance used), is placed in position. The rate at which the fluid in the globe shall percolate the cotton wick and drop into the hot water beneath, is easily regulated. If it should not drop with sufficient rapidity, one or two of the threads of cotton may be removed. Should it drop too rapidly, this is corrected by pressing in the cork more

tightly, or introducing one or two additional threads of wick.

Eight ounces of a saturated solution of chlorinated lime may be poured into the glass globe; and into the water of the porcelain dish, two ounces of the diluted sulphuric acid of the Pharmacopœia. As the solution drops, the acid seizes on the lime, and the chlorine is evolved in connection with aqueous vapor.

Prof. JOS. PANCOAST, of Philadelphia, reports (*Trans. Am. Med. Ass'n*, 1850, vol. iii, p. 135) the cure of a particular form of aphonia by means of the inhalation of the vapor of chlorine. The form of aphonia is that inferred to be due to partial paralysis of the intrinsic muscles of the larynx.

As an inhaling apparatus, Dr. Pancoast used the ordinary tubulated glass retort of the chemist, with a glass funnel having some filtering paper at the bottom. In the bowl of the retort he placed a solution of the chloride of soda, or lime. Into the glass funnel was put a weak solution of muriatic acid in water. As the dilute acid fell drop by drop into the bowl of the retort, chlorine was very gradually liberated and breathed from the end of the instrument.

In using this apparatus, some care is required that the acid solution should not be allowed to drop too freely on the salt in the bowl of the retort, so as to develop the gas too freely. But the patient has the means of protecting himself against too strong an impression of the chlorine on the glottis, by diluting it with air drawn in through the nostrils, a measure to which he would instinctively resort.

The first case in which this method was employed, was a healthy young country girl, who had contracted

a severe cold by remaining in a damp spring-house. The aphonia had lasted for six months, resisting every sort of treatment.

She was placed upon the inhalation of chlorine, continued for some minutes, and repeated two or three times a day, according to the degree of irritation it produced in the throat and larynx. From the first trial, the patient's voice improved, and in three days had become very nearly as strong as ever. A couple of months after her return to the country, another cold was followed by a similar case of aphonia. The patient again breathed the dilute chlorine vapor for a few times, and had her voice restored.

The second case was that of a well-known practitioner whose voice had been lost for about seven months, so that he was unable to practice his profession. Besides exhausting the more ordinary means resorted to in these cases, he had made, without any good effect, repeated trials of a strong lunar caustic solution, applied with a sponge to the glottis.

His voice began to improve from the first trial of the chlorine. The improvement was steady, but more slow than in the case above detailed, a week or ten days elapsing before his voice was restored to its natural strength.

Dr. Pancoast considers that the chlorine acts merely as a local stimulant, and that iodine, or any other exciting vapor would effect similar results.

### *Inhalation of Vapors of Iodine.*

The close resemblance between tuberculosis and scrofulosis, and the well-known alterative effects of iodine upon diseases of the latter character, especially



as they affect the lymphatics and other glands, readily led to the employment of the same remedy in pulmonary consumption; and the volatile nature of iodine suggested its employment by inhalation, for the treatment of affections of the respiratory organs. This vapor has been found of decided efficacy in confirmed phthisis, and in certain forms of catarrh, by Berton, Sir James Murray, Baudelocque, Huette, Chartrouille, Lugol, Chomel, Laennec, Piorry, Dechambre, Corrigan, Scudamore, and many other well-known authorities.

PIORRY read a paper on the subject of the treatment of phthisis by iodine inhalations, before the Académie de Médecine (*Comptes Rendus*, Jan. 24, 1854, see *Ranking's Abstract*, vol. 20, p. 70) (*Archives Générales de Médecine*, March, 1854, p. 361), in which he treats of it in very high terms. M. Piorry, after mentioning the circumstances inducing him to employ inhalations of iodine in the treatment of phthisis, says that the results of the experiments, instituted by himself in conjunction with M. Deyne, an interne of his service, were very satisfactory. A striking amelioration took place in many of their patients, which amelioration was permanent, inasmuch as several patients, mentioned in his work on Practical Medicine, were still in the enjoyment of good health.

The successful treatment of hydrocele and tuberculous diseases of the testicle, by injections of solutions of iodine, led to the inference of obtaining similar benefit in pulmonary excavations, but the difficulty, not to mention the temerity, of attempting the injection of tincture of iodine into a pulmonary cavity, or into the air-passages, led to the plan of employing the vapor of

iodine. Sometimes the crystals of iodine were employed to evolve the vapor, and sometimes the tincture of iodine was used. In the former instance, two or three scruples of iodine were placed in a wide-mouthed quart jar, from which the vapor would be disengaged spontaneously with greater or less rapidity, according to the temperature and humidity of the atmosphere.

In other cases, one to three ounces of the tincture of iodine were poured into the jar, which was then heated until the vapors of iodine and alcohol were given off. The patients breathed the vapors, taking one deep sighing inspiration at a time, and repeated the effort from one to two hundred times daily, at appropriate intervals, several successive inspirations producing pain in the larynx and bronchi, with cough, although the single inspirations did not produce much irritation.

With Laennec, who surrounded the bed of his consumptive patients with the varec, in order to procure the iodinated vapor, Piorry, too, employed inhalations of iodine during sleep. He placed several saucers containing iodine about the patient's pillow, or attached a number of vials of iodine to the bedposts, so as to saturate the air with iodine, which is given off in sufficient quantity to blue any starched curtains that may be about the bed.

Piorry calls attention to the circumstance, that if a moist starched paper is interposed between the vessel from which the vapor is being liberated, and the patient's mouth, as he takes an inspiration, it turns blue, while the same air breathed upon the paper, after having traversed the lungs, causes no change; from which fact he infers, that the iodine which enters the lungs is absorbed there.

The treatment of Piorry's cases was not confined to the iodine inhalations. Most of them took from twenty to sixty grains of the iodide of potassium by the stomach daily. In cases of supposed adhesions, frictions were resorted to with tincture of iodine, one part to nineteen parts of water. Other remedies, as astringents, opiates, and other narcotics, quinine, &c., were given to fulfil various indications; while a nutritious and reparative diet was employed, to which regimen Piorry gives a preference over all the remedies employed, except the iodine.

Thirty-one patients were thus treated during a period of two years, all presenting in different degrees unmistakable signs of phthisis, with the characteristic sputa, and positive plessimetric and stethoscopic evidences of the disease.

In order to determine with precision the effects of the iodine, some charts were prepared, upon which were marked exact delineations of the parts diseased, and representations of the variations in sound upon percussion, which occurred from day to day. After periods varying from four, six, or twenty days, to from six weeks to four months of the iodine treatment, there was in almost every case a diminution of the extent of the surface over which there was at first feebleness of respiration, dulness, resistance, &c., while at the same time, auscultation indicated an amelioration in the condition of the condensed portions of the lung. Numerous patients with cavities in the lungs were apparently cured.

The ultimate results were: decided amelioration in the symptoms and anatomical characters in twenty cases; disappearance of the anatomical characters and

of most of the symptoms in seven cases ; death with or without amelioration in four cases.

M. Piorry's conclusions are as follows :

1st. The inhalation of the vapor and tincture of iodine is useful in the cure of phthisis.

2d. In many cases, such inhalation is followed by a diminution in the extent of the indurated parts surrounding tuberculous deposits, and an amelioration in the general symptoms.

3d. It is probable that tubercle itself disappears under the influence of iodine inhalations.

4th. That inhalations of the tincture of iodine may promote the cure of tuberculous cavities.

5th. That after the softening of tubercles, the resulting cavities may cicatrize spontaneously.

6th. That compression of the thorax over the points of disease indicated by percussion and auscultation, may contribute to the cure of the local lesion, and to the prevention of pyæmia.

7th. That iodide of potassium administered internally, and frictions with diluted tincture of iodine over adherent portions of the lung, are also of great utility.

Sir CHAS. SCUDAMORE found the irritating qualities of the gas subdued by the addition of a little tincture of conium at the time of employing the inhalation, a higher heat being necessary to liberate the vapors from the conium than is necessary with iodine alone.

Sir Chas. Scudamore (*London Med. Gazette*, February, 1840), after ten years' experience with iodine inhalations, had acquired increased confidence in their efficacy. His formula at this time was 6 grs. each of iodine and iodide of potassium, with 2 drachms of alcohol, to 5 ounces of distilled water, adding a little tincture of

conium at the time of mixing the solution of iodine with the water for inhalation. He began with a drachm or so of the iodine mixture, two or three times a day, increasing the dose, if necessary.

The vapor of iodine may be inhaled from a solution of the tincture in water, by means of a Wolfe's bottle, or other inhaler, no artificial heat being necessary.

Dr. BERTON's method consisted in placing into a flask with two openings, some dilute sulphuric acid, to which is added a quarter or half a grain of the hydriodate of potash; the iodine vapors are promptly disengaged, and are inhaled by the patient from one of the tubes from the flask, the process of inhalation occupying four or five minutes, and being repeated as often as desirable, even to the number of ten times a day.

Dr. PEREIRA's experience in phthisis, as well as other chronic pulmonary complaints, has not been favorable.

M. SIMON relates (*Brit. & For. Med.-Chir. Rev.*, July 1861, *from L'Union Médicale*, March 16, 1861) the results of a number of cases of phthisis pulmonalis treated by M. CHARTROULLE with inhalations of iodine, a practice very frequent in Belgium. Under his directions, twenty-eight patients in the hospital were treated by the inhalation of the vapor of pure iodine, and of this number only eleven could be said to have derived no benefit from the treatment. In these unsuccessful cases the pulmonary lesions were not modified, but still, the symptoms were not aggravated in any case. In opposition to the statement that iodine vapor produces hæmoptysis, it was found that pulmonary hemorrhage ceased more rapidly under this kind of treatment than under other plans which are more generally employed. Seventeen patients derived positive benefit from the iodine treatment,

and this improvement was observed not only in relation to the general symptoms, but also to the pulmonary lesion itself, as was proved by percussion and auscultation. Out of the seventeen patients but four might be considered as actually cured. One of these cases of cure is the following: A youth 16 years of age, entered the hospital in such an alarming condition that at first the physicians hesitated to submit him to the iodine inhalations. He was in a state of great emaciation, and his skin was almost constantly covered with profuse perspiration; he had diarrhœa, which had lasted for two months, and he had repeatedly suffered from hæmoptysis. There were very extensive indurations in the lungs, and at the apex of the right lung there was a cavity of some size, as was shown by very obvious *gargouillement*. The expectoration also was characteristic. After resting a few days, this young man was subjected to the iodine inhalations, and all the symptoms which had appeared so serious were soon modified in a most remarkable manner. The general symptoms disappeared first, and the body recovered its plumpness with great rapidity. The perspiration, diarrhœa, fever, cough, and expectoration, were soon relieved or removed, and six weeks after admission into the hospital the patient went out quite well.

Several other cases of the same nature are recorded from both the public and private practice of M. Chartrouille, and in all of them the beneficial results of iodine inhalations are remarkably exhibited. Dr. Simon, who relates the cases, attributes a great part of the efficacy of the treatment to the apparatus employed for inhalation, which, however, is not described in the paper. By this apparatus, it appears, a degree of precision is given

to the treatment which consequently becomes the more efficacious, for a dose of the vapor may be estimated with exactness, and the remedy may be made proportionate to the severity of the disease and the strength of the patient.

LEWIN (*op. cit.*, p. 202) had employed vapor of iodine in phthisis several times without any favorable results, but all his cases were in the advanced stage.

The inhalation of iodine vapor has been employed in coryza. An army surgeon, M. LUC, seized with very bad coryza, attended by fever, severe cephalalgia, and excessive secretion, determined upon trying the effect of the inhalation of iodine vapor. The coryza first appeared at 9 A. M., and the inhalations were commenced at 3 P. M., being repeated every three minutes during an hour, each lasting about a minute. The headache was first relieved, the sneezing then occurring less frequently, the amount of secretion diminishing, and by 6 P. M., all traces of the coryza had disappeared, except a little burning sensation in the throat. Several of the officers have since tried the means with the same results. The inhalation is effected by placing a bottle of tincture under the nose, the hand supplying warmth enough to vaporize the iodine. (*Rev. Méd.*, August 31; *Med. Times and Gazette*, November 11, 1865; *The Med. Record*, March 1, 1866.)

Dr. A. P. MERRILL, of New York, formerly Professor of Materia Medica in the Memphis Medical College, and editor of the *Memphis Medical Recorder*, has for a number of years made extensive use of the inhalation of the vapors of iodine in mucous inflammations of the trachea and bronchi, led to the treatment by the happy results previously obtained in his own case and that of others,

by its local application in a convenient form, in cases of chronic pharyngitis and laryngitis. These cases are reported in the *Memphis Medical Record*, vol. i, 1852-3, pp. 8, 21, 113; vol. iii, 1854-5, pp. 133, 187, 228, 285; vol. iv, 1856, pp. 252, 377.

Dr. Merrill employs the vapor disengaged directly from the crystals of iodine, which are sufficiently volatile in a current of cold air to afford all the strength of vapor that can be conveniently borne by the patient. I make a few extracts from some communications on this subject, kindly furnished me by that gentleman. "In a case of such inflammation beyond the reach of the brush, I found a patient inhaling the vapor of gum camphor through a common quill, but without much effect. I added a few grains of iodine to the camphor, and then the relief obtained was more decided; but in applying this combination to other cases, I met with a difficulty in the liquefaction of the mixture, and then determined to use each remedy separately, by placing it within a small cane tube, with a little coarse wool in each end to prevent the escape of the medicine. I have used tubes of glass, also, but found them to hold the remedies less securely. The cane tubes have answered an excellent purpose, whether employed through the medium of the mouth or the nasal passages, but more recently I have substituted tubes made of hard rubber, so rounded at the ends as to prevent irritation, and the vapor escapes through several perforations at the extremity. With these tubes, which unscrew at the middle for the introduction of the iodine, the teeth, tongue, &c., are protected from any disagreeable effects of the vapor, and the current may be made to impinge in any desired direction.



“Great benefit is derived from iodine inhalations in the more acute affections of the nasal membranes, such as coryza, hemorrhage, and catarrh. They relieve the habitual catarrh of old people, and are advantageous to public speakers and singers, whose vocal organs have become debilitated from excessive exercise in their vocations, and which sometimes show a tendency to œdema of the glottis, and terminate in aphonia.”

Dr. Merrill details (*Am. Jour. Med. Sci.*, Jan. 1866) an interesting case of symptomatic bronchial irritation, in which the iodine inhalations were very beneficial. These were made with tubes of cane in the manner previously described. He considers that the iodine acts in chronic cases by exciting a watery secretion which disengages the viscid mucus which frequently induces coughing by its titillation, and that it relieves hyperæmia and hypertrophy. He has found benefit from inhalations of iodine vapor, in croup, in œdema of the glottis, and aphonia.

In cases of children, and people unwilling or unable to inhale properly, he attaches a gum hand-bellows by a rubber tubing to the tubes, and thus forces the vapor into the nasal or laryngeal passages.

Dr. Merrill has kindly furnished me with the following notes of a case of profuse bronchorrhœa, which was suppressed by inhalations of iodine.

“Mrs. McL., aged 70 years, had suffered for several months with cough, constipation, and œdema of the feet and legs, with incontinence of urine. She complained especially of excessive expectoration, which had reduced her almost to a skeleton, and it was with difficulty she could walk across the room. I did not see the matter expectorated, which was so offensive that she

declined saving it, but both she and her daughter estimated the quantity latterly at a pint to a pint and a half every morning, for it was only in the morning that her cough troubled her. Beginning at three to four o'clock, it continued several hours, during which time the expectoration was free and profuse, and she often passed the remainder of the day without coughing at all.

"I gave her an inhaling-tube, charged with iodine, to be used frequently during the day and night, and directed her to take one-tenth of a grain of arsenious acid three times a day, together with half a grain of calomel at night. This course was continued twenty days with progressive improvement, when (June, 1867) she was entirely relieved of the bronchial disease, and the iodine inhalations were suspended."

*Inhalation of Nitrous Gas in Whooping-cough.*

Dr. THOMAS records (*Am. Med. Recorder*, 1822, p. 660) a case of pertussis of nearly three weeks' duration, which was cured within ten days by the inhalation of nitrous gas. The patient was his own son, aged between four and five months, and he was led to the use of the remedy from the perusal of some cases treated by this gas by Mr. Patterson, in J. Carmichael Smith's work on Nitrous Vapor, to which his attention was called for the purpose by a professional friend. He closed every aperture of the apartment occupied by the little patient, which might afford exit to the gas; he then placed a teacup in a sand-bath, poured half an ounce of sulphuric acid into the cup, to which he gradually added half an ounce of pulverized nitrate of potassa, so as to occupy an hour each night in the disen-

gement of the vapor. The application did not provoke cough, and the child usually fell asleep at an early hour. The treatment began on the night of July 30th, and after that of August 1st, there was no more whooping, and in ten days the child was well. Dr. Thomas concludes thus: "In the foregoing case it appears evident to me, and I trust it will to all those who read it, that the *vis medicatrix naturæ* had no agency in relieving the patient. I am willing at all times to pay due homage to that power, but not at the expense of truth and justice; let us, therefore, 'render unto Cæsar that which belongs to Cæsar,' and not ascribe merit where none is due."

#### *Inhalation of Sulphurous Vapors.*

The inhalation of sulphurous vapors has been employed from very early times. Galen, it is known, recommended patients with various affections of the respiratory organs to frequent the neighborhood of Mount Vesuvius, to respire the air loaded with its sulphurous emanations. They were also employed by Celsus.

Recently (*Lewin*, p. 4) sulphurous vapors have been much employed in chronic bronchitis by the French physicians, principally Pujade, of Amélie les Bains.

Dr. JAS. DEWAR (*Dublin Medical Press and Circular*) speaks highly of the benefit of using the sulphurous acid fumes in the treatment of typhoid, ephemeral, and scarlet fevers; in diphtheria, gout, and rheumatism. He saturates the atmosphere of the patient's room with the vapor. (*The Medical Record*, vol. 1, p. 395.)

The manufacture of sulphuric acid, it is asserted

by M. BAUMES (*Dictionnaire des Sciences Médicales*) protects those employed against phthisis, even restoring to health those that seem to have been predisposed to the disease. (Coxe, *On Medical Inhalation*, Phila., 1845.)

*Inhalation of Carbonic Acid in Phthisis.*

The statement of M. GUILLOT (*Archives Générales de Med.*, Jan., Feb., and March, 1845; *Ranking's Abstract*, 1845, vol. i, p. 211) that the dark-colored matter found in the lungs under certain circumstances, and which, according to Dr. CARSWELL, is a physiological carbonaceous deposit due to stagnation of the blood in the pulmonary tissues, possesses the remarkable power of inducing a modification in tuberculous deposits, led to experiments as to the power of arresting phthisis by instituting inhalations of carbonic acid gas as a remedial agent. Certain Russian physicians reported favorable results a few years subsequently, but the subject does not seem to have attracted much attention outside of their own country, and has most likely fallen into disuse there.

*The Inhalation of Illuminating Gas.*

The vapors of illuminating gas have been employed in cases of whooping-cough. Early in 1864, at Amsterdam, children with this affection were sent to the place of manufacture of the burning gas, and allowed to breathe the gaseous atmosphere for a certain period, with very satisfactory results, many cases having been considered to have been cured in this manner, and without injurious results in any one instance.

The same method was employed at Calais in the

winter of 1864, during an epidemic of pertussis, a number of children thus affected being sent to the gas-house to breathe the vapor at the moment of escape after subjection to the purifying process. As soon as the children breathed this air they began to improve, and thorough cures resulted. Two or three visits sufficed to put an end to the paroxysm of cough.

Other investigations were made in this direction about the same period. Thus we see (*Am. Jour. Med. Sci.*, April, 1865, p. 487, from *Brit. Med. Jour.*, Nov. 5, 1864) M. COMMERGE presented to the Imperial Academy of Medicine, a report on this subject drawn up from the observations of the effects produced on one hundred and forty-two children affected with whooping-cough, and who had been brought under the action of the gases in the gas-works at St. Maudé. His conclusions are to the effect that the treatment produces excellent results, and at all periods of the disorder. In general, twelve séances are required for the cure, and each séance should be of two hours' duration. However young the patients, no danger results from the exposure to the gases. Then again, we have Dr. BERTHOLLES, who informs the French Academy of Medicine of the effects observed to result from the inhalation of the vapors disengaged from the remains of the materials used in the purification of gas, by children having whooping-cough. The register of the coal works at Ternes show that, during the past six months, nine hundred and one patients have been subjected to this vapor treatment, and that of these, two hundred and nineteen were cured, and one hundred and twenty-two relieved. The favorable results are probably due to the ammoniacal gases and the tar vapor associated with it.

See more recently on the same subject *Schmidt's Jahrbücher*, July, 1866, p. 63.

In this connection it will be interesting to record here the results of some experiments performed upon cases of whooping-cough, at the St. Annen Children's Hospital, of Vienna, with the view of determining the effect of the inhalation of various gases in the treatment of this affection.

These results are summed up as follows:

1st. Inhalation of pure oxygen gas did not, in any instance, produce paroxysms of cough.

2d. Inhalation of nitrous oxide gas, or of a mixture of oxygen and atmospheric air in equal parts, did not produce a single paroxysm of cough, even when the inhalation was continued for a considerable period. The children inhaled it with eagerness for from five to ten minutes, and would have continued to do so longer, had permission been allowed.

3d. Inhalation of pure nitrogen and hydrogen was attempted only on a single occasion; the children breathed it very unwillingly, and only for a very short period. In two cases, the inhalation of nitrogen was interrupted by paroxysms of cough. Inhalation of hydrogen produced disposition to cough in one case.

4th. The inhalation of carbonic acid gas always produced a very heavy fit of coughing at the first deep inspiration, even when the experiment was continued for a very short time. An experiment was made with a mixture of one volume of carbonic acid gas with fifteen volumes of ordinary air, which always produced a fit of coughing, either immediately or within two or three minutes. With further dilution the result was not constant, but fits of coughing followed much more

frequently than from the inhalation of pure atmospheric air.

5th. A very slight proportion of ammoniacal vapor, so slight that it could not be detected by the sense of smell, in the limited number of cases in which it was tried, was followed by constant severe paroxysms of cough.

Dr. HAUKE, in summing up the practical results of these experiments, and arguing from the fact that carbonic acid gas is the gas most obnoxious to whooping-cough, on the ground that there is some arrest of the separation of carbonic acid gas in the lungs, puts the following question: Does this arrest or hindrance to the separation of carbonic acid gas from the lungs of children laboring under whooping-cough, throw any light upon the cause of the peculiar fits of coughing? His anatomical and clinical experience assures him that such is the case, and although his investigations have not furnished any specific remedy against whooping-cough, some valuable assistance has been gained in decreasing the number and severity of the paroxysms of cough.

These investigations appear to substantiate the old advice to permit whooping-cough patients, free from fever, to be out in the open air as much as possible on still, sunny, summer days. In the confined space of a sick-room, the air loaded with carbonic acid gas, and the volatile ammoniacal particles of the various excretions, is in itself sufficient to induce cough. Out in the open air, on the contrary, where nature furnishes in every leaf an apparatus for the generation of oxygen, not only is such injurious effect prevented, but the greater liberation of carbonic acid gas, by promoting

the respiratory process, will have a calmative effect upon the paroxysm. When the state of the weather is such as to prevent the egress of the child into the open air, it is advisable on the same grounds, to place in the chamber many-leaved, blossomless plants, meagre in perfume, so as to increase the proportion of oxygen in the atmosphere of the apartment, particularly for a few hours after a meal, because at this time the production of carbonic acid in the organism reaches its maximum. For similar reasons such articles of nutrition should be selected as are least productive of carbonic acid gas, and which by their high oxidation, require but a small quantity of oxygen for their combustion in the system. Therefore the diet most appropriate under such circumstances, are materials rich in fatty constituents, such as milk, sugar, and starches. On the same principles, great attention should be paid to the condition of the skin, by the use of frequent ablutions, baths, &c. (*Jahrb. für Kinderheilkunde*, 1862; *Med. Neuigk. für Aertzter*, *Erlangen*, 1862, No. 22; *Lewin*, p. 202.)

The inconvenience often attendant upon sending children with whooping-cough to the gas-works, a practice which he had pursued with good effect in 1864, led Dr. LOCHNER (*Gazette Medicale*, Oct. 20th, 1866) to the attempt to employ at home, in the case of his own son, one of the substances contained in the purifying chambers of the gas-works, and he selected benzine, with the vapor of which he kept the room impregnated by pouring a few drops upon the bed of the patient. In the case of his own child, in whom the paroxysms were very violent, though only numbering five or six in the twenty-four hours, the disease lasted but six days. He also employed the benzine internally, ten or fifteen



drops daily in a little water; and when the child was sleeping, sprinkled a few drops upon the bed.

### *Inhalation of Chloroform.*

The inhalation of chloroform has been recommended in whooping-cough by Dr. FLEETWOOD CHURCHILL as controlling the disposition to cough, the whoop, &c. (See *Braithewaite*, 1853, p. 93.)

Mr. G. H. HEATH, of Newcastle-on-Tyne, reports that in cholera, cases where the vomiting is excessive will sometimes be controlled by inhalations of chloroform, when nothing else will do so; and life may in this way be saved. (*Lancet*, Oct. 15th, 1853.)

The inhalation of chloroform has been recommended in asthma, also in spasmodic croup, in order to overcome the spasm. It is also employed for a similar purpose in angina pectoris, colic, and other painful affections, without pushing the administration to the abolition of sensation or consciousness.

Its uses as an anæsthetic do not come under consideration in this volume.

### *Inhalation of Sulphuric Ether.*

Inhalations of sulphurous ether have been recommended as almost an abortive in pneumonia. Skoda states that he has never seen it exercise any modifying influence, even in the earliest stages.

They have been highly recommended in whooping-cough, spasmodic asthma, and in chronic affections of the air-passages generally, and it is not unlikely that much of the benefit arising from the inhalation of ethereal solutions of the balsams is due to the sulphuric ether.

Inhalations of “naphtha vitrioli” (sulphuric ether), were recommended by Joerdans (*Copland's Dict.*) in certain affections of the respiratory organs.

Ether, impregnated with musk, camphor, assafoetida, opium, &c., is sometimes preferable to pure ether.

Inhalations of sulphuric ether, alone or combined with the vapor from preparations of conium, were advised by Dr. RICHARD PEARSON in cases of phthisis, as an agent in abating the hectic, checking the sweats, relieving the dyspnœa, and deodorizing the sputa. He does not recommend them as curative, but as affording very grateful relief to such patients, who will not willingly discontinue their employment, after having once experienced their benefits.

Inhalations of ether, impregnated with squill by the addition of the tincture, are recommended in asthma by the same authority. (Coxe, *On Medical Inhalation*, Philadelphia, 1845.)

SCUDAMORE employed inhalations of ether in spasmodic asthma.

Dr. EBERLE recommended the inhalation of ethereal vapors in pulmonary affections. He considered them of very great value in relieving dyspnœa. (Coxe, *op. cit.*)

In the dyspnœa dependent on chronic bronchitis, Prof. WOOD considers the inhalation of ether doubly useful, if carefully managed, both by relieving the distressing sensation, and favoring mucous secretion. (*Wood's Therapeutics*, 2d edit., vol. ii, p. 697.)

Dr. PHYSICK, of Philadelphia, was in the habit of employing the vapor from equal parts of Hoffman's anodyne and laudanum, in cases of recent catarrhs, in coryza, and obstinate hoarseness; and its value in these

cases is attested by Dr. Chapman in his work on Therapeutics.

Dr. W. Y. GADBERRY, of Lexington, Kentucky, records in the Nashville Journal of Medicine and Surgery, October, 1866, some cases of capillary bronchitis treated effectually with inhalations of ether.

The same gentleman has furnished me with the following notes of the effect of the same treatment in a case of acute bronchitis: "Early in the winter of 1866-7, the Rev. Mr. B——n left Lexington, Miss., for Cincinnati, Ohio, suffering with catarrh, and returned in ten days with a violent attack of bronchitis and diarrhœa. During the first week his fever was high, with a pulse ranging from 110 to 130. He complained of oppression of the chest, dyspnœa, and loss of sleep. After a week's trial with the remedies usually adopted in such cases, I became alarmed for the safety of my patient, and determined to use inhalations of sulphuric ether. By it the dyspnœa was immediately relieved, sleep became natural and refreshing, his harassing cough gradually subsided, and he soon recovered. He took it at intervals, *pro re nata*." Dr. Gadberry informs me that he had recently asked this patient his opinion of the efficacy of the ether in his case, and he assured him that it had given decided and permanent relief.

In a letter to Dr. Gadberry, from Dr. W. H. Williams, of Lexington, Kentucky, the latter gentleman writes under date of April 15, 1867: "During the spring of 1866, I was the subject of severe bronchial catarrh, which persisted for many weeks, resisting the ordinary course of treatment prescribed by adapted authorities, when, at your suggestion, I began the use of ethereal inhalations, the disease at this time having as-

sumed a gravity well calculated to arouse my suspicion of approaching tuberculosis. I first used sulphuric ether, and it served well the purpose of relieving the frequent paroxysms of dyspnœa, which, though not severe, were extremely annoying. Subsequently I adopted the use of equal parts of ether and tar, and with more gratifying results than I had experienced from the use of ether alone.

“The combination seems to promote a free and easy, yet not a copious expectoration, but on the contrary exhibits a decided tendency to overcome the hypersecretion. This, perhaps, is due to a sedative and antiphlogistic influence exerted by the tar-vapor upon the inflamed mucous membrane. I pursued this course for some weeks, to my entire relief.”

Dr. SAMUEL W. FRANCIS, of Newport, Rhode Island, writes me that he has employed inhalations of ether for a bad sore throat, to which he is subject, and feels confident that the inhalation not only alleviated the symptoms but cured the sore throat; and he has formed the opinion that we have a valuable remedy by this means, in the treatment of bronchitis.

The inhalation of sulphuric ether has been recommended from various sources as a valuable remedy in cases of hysterical or nervous aphonia. I have myself on several occasions, been able to restore the voice in cases of aphonia in this way, but all of my cases occurred in military practice during the late civil war, and I have no reason to believe that they were not those of malingering in every instance. It was curious to notice in some of the cases, after the subjects had learned the object of placing them under an anæsthetic influence, how well they could control themselves while going under

the influence of the ether, not a sound escaping them until the moment of unconsciousness; but, oblivion having once ensued, the effect in coming-to was not anticipated, or if anticipated, was forgotten under the anæsthetic state, and the intoxication would be evinced by the usual clamors, when a sudden restoration of consciousness would announce to them, with a moral shock, the cure of their aphonia.

I have, however, succeeded in restoring the voice in cases of so-called nervous aphonia, by the injection of sulphuric ether into the larynx, but here the result was due to the local stimulus, rather than to the therapeutic effect of the ether.

Dr. F. D. LENTE, of Cold Springs, New York, records (*Am. Med. Times*, April 6, 1861, p. 224) a case of hysterical aphonia cured by the inhalation of sulphuric ether. This was an unmarried female, æt. 40, who had been an invalid for several years. Early in 1860 she lost her voice so that she could not articulate above a whisper. In December of that year she was placed under the influence of sulphuric ether for the reduction of a strangulated femoral hernia, and twice, on recovering from the anæsthetic influence, the patient expressed her belief that she articulated with less effort, although she still spoke in whispers. Brought a third time under the influence of the ether, preparatory to the operation, certain attendant circumstances kept her under the influence of the ether for two hours, and as soon as she had fully recovered from its effect she exclaimed aloud—"Doctor, I can speak!" and her voice remained permanent up to the date of the report.

Dr. Lente instances a case reported a short time previously, in which a carman of London recovered the use

of his voice after a deprivation of eight months, while under the influence of chloroform, for the purpose of overcoming some rigidity about the muscles of his jaw.

Dr. L. NORDMANN, of this city, writes me under date of April 6th, 1867, that at Haddington U. S. A. General Hospital, he had under his charge, in 1864, three cases of complete aphonia in United States soldiers, young men otherwise healthy. These men were not considered malingerers by himself nor by his colleagues. They each had made a similar statement, that loss of voice followed a severe cough contracted during prolonged exposure to wet and cold while on duty, some three months previous to his seeing them. Having heard of a case of aphonia successfully treated in Baltimore by inhalations of sulphuric ether, Dr. Nordmann determined to try the effect of the inhalation of ether on these cases, and as the effects of the anæsthetic passed off, each, to his great surprise, had recovered the proper use of his voice.

Dr. JAMES H. HUTCHINSON, of this city, reports (*Am. Jour. Med. Sci.*, April, 1864, p. 412), a case of loss (hysterical) of speech and hearing successfully treated by the inhalation of ether. C. C., a German girl, æt. 20, was admitted to the Episcopal Hospital, September 22d, on account of entire loss of speech, which had occurred ten days previously. Complete deafness supervened two weeks after her admission.

The history of the case is as follows : She had always enjoyed good health up to two and a half years previous, when she was about to leave Germany for this country. At that time she had a violent quarrel with her fellow-travellers, which gave rise to a hemorrhage from the lungs. During the voyage she had several convulsions,

but upon her arrival in this country she was sufficiently well to take the place of cook in a private family, and she continued in good health, with short interruptions, up to September of 1863. Dr. Hutchinson found her in the wards of the hospital when he took charge of them at the beginning of the year. He learned that she had had but few convulsions while in the hospital, and that the usual remedies had been tried without relieving her condition. Electricity, the various tonics, nux vomica, and lastly, sulphate of aniline, had all been resorted to without benefit. During all this time, her only means of communication with others was by means of a slate. Dr. H. was anxious to discover whether the loss of speech and of hearing was in any degree feigned, and with that view the resident physician was directed to administer ether to her by inhalation, in the belief that if such were the case, she would find words as she came under the influence of the anæsthetic. The result, however, was different from what had been expected. The ether threw her into a slight convulsion, from which she soon recovered, having entirely regained her hearing. The experiment was directed to be repeated twice subsequently. Upon recovering her consciousness she was able to say *mamma*, and to make various inarticulate sounds. She was a third time (three days later) placed under the influence of ether, with the following curious result,—that of recovery of speech and loss of hearing. A fourth etherization produced no immediate result; but in the course of a few days after, she was able first to hear loud noises, and later, to understand what was said when spoken in a loud tone of voice. The improvement after this was very rapid, and by the middle of January her recovery

was complete. She was retained in the hospital for observation until the beginning of February; but as she continued quite well, she was discharged at this time at her own request. Her joy at her recovery may well be imagined, as all hope had been abandoned by herself and friends, by whom application had been made to the managers of the Deaf and Dumb Asylum, for her admission to that institution.

The Montreal *Gazette Médicale* publishes from *L'Abbeille Médicale*, the report of two cases of diphtheritic angina, or false membranous croup, treated with success by inhalations of ether, under charge of Dr. M. BESSON.

The first patient was a girl six years of age, who presented the following symptoms: Swelling of the submaxillary glands, puffed face, pulse slightly accelerated, pain in the throat, difficulty in swallowing, mucous membrane of fauces engorged and reddened, tonsils strongly tumefied, and presenting several patches of the pellicular exudation which characterizes diphtheritic angina. Voice gone; cough dry, choking, and croupy. Respiration short, accelerated, and labored. The patient was at first treated in the usual manner,—by vomits of tartar-emetic and ipecacuanha, &c., chlorate of potassa, mercurial frictions around the neck,—with no effect, however, except the expulsion of some membranous shreds and patches. As a *dernier ressort*, Dr. B. thinking it unadvisable to resort to tracheotomy, inhalations of ether were employed. The effect was an attack of suffocation, accompanied by a violent respiratory struggle, lasting nearly a minute, during which a false membrane, over six centimetres in length, and three millimetres in thickness, very dense, like a piece of parchment, was



expelled. The effects of this paroxysm gradually subsided, and the patient soon went into a calm sleep. After about eight hours the symptoms recurred, and again recourse was had to the ether fumigations, resulting in further expulsion of false membranous exudation. Calm and sleep again supervened, the croupy symptoms yielded, and in a few days complete recovery had taken place.

The second patient was a little boy, five years of age, who was attacked with diphtheritic angina. Vomits of sulphate of copper, &c., had been used, followed by the expulsion of some false membrane, but still the symptoms became aggravated. There was complete aphonia, tonsils tumefied, and covered with whitish patches; cough insonorous and choking; successive dyspnœa; convulsive movements of the expiratory muscles; quick, sibilant inspiration; face congested; eyes injected; jugulars distended; extreme anxiety, convulsive agitation, and intense fever. In short, the patient was in the midst of these terrible paroxysms, which have hardly any remission, and which announce that the final symptoms of asphyxia are near at hand. In this condition the patient was made to inhale, in the space of several minutes, about five drachms of vaporized ether, and soon afterwards, in the midst of the violent efforts of a veritable strangulation, he expelled, enveloped in thready mucosities, a false membrane, seven to eight centimetres long, two centimetres in its greatest circumference, and very dense. In half an hour the symptoms of amelioration had become so decided, that the disease was thought to be broken, and during the forepart of the night the little patient rested quietly.

Towards midnight, the dyspnœa and the paroxysms became again urgent and violent, so that the patient himself cried for the use of the ether. This second fumigation produced the expulsion of several pieces of false membrane, rolled upon themselves, but smaller than the previous one. Again, subsidence of the croupy symptoms, and their occasional re-occurrence during the next two days, when the ether was again applied.

The patient finally recovered.

The evaporation of the ether in these cases was accomplished by very simple means, placing a bottle containing the ether, and terminating in an extemporized tube, into a bowl of water of 40° Cent., the ether fumes were thus carried from the tube with the air of inspiration into the air-passages. (*Med. and Surg. Reporter*, Philada., April 25th, 1866.)

Dr. R. R. LIVINGSTON, of Plattsmouth, Nebraska, communicates to the *Am. Jour. Med. Sci.*, April, 1867, p. 376, the particulars of a case of laryngitis with exudation of lymph, treated with inhalations of sulphuric ether. On the 4th of January, Dr. L. was called to a little girl æt. two, the messenger informing him that the patient had croup, and was dying. Previous to his arrival, the mother had administered a full dose of syrup of squills, and he found the patient vomiting and purging freely. Pulse 150; tongue slightly coated, somewhat swollen, and red; fauces red, with an engorged appearance; tonsils slightly swollen; considerable tenderness over the larynx; eyes watery; breathing slightly stridulous, the mother stating that previous to emesis it was very labored, or, as she expressed it, "the child was choking;" countenance expressive of great anxiety; and

though no coughing occurred at the time of the doctor's visit, he was informed that she had coughed repeatedly with a ringing, croupy cough.

Inhalations of lime-water were directed, as hot as could be borne by the child; also one of the following powders every two hours, viz.: *Ry. hyd. chlor. mit., gr. x.; antim. et pot. tart., gr. j.; ammoniæ hydrochlor., ʒj; M. ft. chart. No. xii.* The mother of the child was instructed to keep a large open kettle of water boiling on the stove, for the purpose of moistening the atmosphere.

About midnight Dr. L. received a most urgent request to visit the child immediately, as she was suffocating. Before entering the chamber of the invalid, he was struck with the loud wheezing noise of her respiration, and the peculiar loud, ringing cough. There was great dyspnœa; respiration performed with difficulty; nostrils dilated; muscles of chest and neck violently exerted; lips livid, and head thrown backwards, with great restlessness, and a slightly cyanosed appearance of the countenance. On inquiry, he was informed that the lime-water inhalations had afforded temporary relief, but that each time they were left off the difficulty of breathing recurred in a short time.

The parents were informed of the perilous condition of their child, for whose recovery tracheotomy appeared to offer the only hope, though with very little encouragement. At this moment, remembering the suggestion of Dr. BLACK and Dr. GADBERRY, he proceeded to administer some of Squibb's ether by inhalation, according to the directions of Dr. LENTE, as reported by Dr. PACKARD in the *Am. Jour. Med. Sci.*, for Jan. 1866, premising the inhalation by the internal administration

of half a teaspoonful, which, as anticipated, was swallowed with difficulty, and caused a severe paroxysm of coughing.

In precisely eight minutes from the time the patient commenced the inhalation, the abnormal muscular exertion ceased; a general relaxation took place; the pulse fell to 100, and the peculiar "flip" sound of partially detached membrane was distinctly heard during expiration; the loud wheezing noise of the breathing abated, and in thirteen minutes the child was sleeping in comparative ease. In about ten minutes more she coughed, not with the loud, ringing, metallic sound so peculiar to this affection, but with the moist râle which every practitioner hails as the harbinger of success in the treatment of this dreadful malady. The coughing was followed by efforts at vomiting, and numerous portions of membrane were discharged, the edges having a whitish, and the centres a grayish appearance; they were oblong in shape, from an eighth to three-fourths of an inch in length, and from half a line to a line in thickness. A few times more, at short intervals, coughing occurred, followed by emesis and the expulsion of additional portions of membrane. The vomiting now ceased, and the child slept almost naturally, the respiration being normal. Her sleep was frequently disturbed by short fits of coughing; but the intervals of rest increased in duration, and no more membrane was expelled, though it was evident that she occasionally swallowed portions without completely awakening. At 4 o'clock the child was out of danger; at 10 A. M. awake and playful. The recovery was entire.

In commenting on this case Dr. LIVINGSTON acknowledges that the previous exhibition of the powders, and

the inhalations of the nebulized lime-water, may render it doubtful if the recovery was entirely due to the inhalation of the ether; and suggesting that the spray of the lime-water is in great measure carbonated by inhalation, and thus rendered inoperative, he attributes the temporary relief afforded by its administration to the warm moisture of the water. But as there was no evidence of permanent relief until the administration of ether by inhalation, and the favorable effect of the latter was rapidly produced under his direct observation, he has no hesitancy whatever in ascribing the recovery to the ether.

Dr. W. Y. GADBERRY, of Yazoo City, Mississippi, has furnished me the following notes of a case of croup treated by inhalations of sulphuric ether :

“On the night of the 15th of April, 1867, I was called, in the absence of the attending physician, to see a child of Mr. M——, æt. eight months. When I arrived the child was in imminent danger of dying from non-plastic croup. It had been relieved on the night previous with emetics of alum and lobelia, and cold applications to the throat. The fever, however, continued up to the time of my visit. I ordered an alum emetic, which acted promptly; applied turpentine and hot flannels to the throat, and a snuff plaster to the chest. In the course of half an hour the symptoms improved some little, but not enough to justify my departure, or any assurance of permanent relief. I then resorted to inhalations of sulphuric ether, which gave complete relief in five minutes to all the difficulty of respiration; nor did it return any more. To relieve the febrile excitement I directed *hyd. cum creta*, to be repeated until it acted on the bowels.”

The anæsthetic virtues of ether do not come under consideration in this volume.

*Inhalation of Balsamic Vapors.*

The custom of sending patients with pulmonary complaints to localities where they might constantly breathe the balsamic atmosphere produced by the vegetation of aromatic plants, is of very ancient origin.

In the middle of the seventeenth century, Dr. BENNET of London employed an artificial atmosphere of this kind, by the fumigations of frankincense, styrax, and turpentine, with coltsfoot, cinnamon, &c., in powder, or made into troches and burned upon coals. He also employed the vapors from mixtures of herbs over which boiling water had been poured. (*Copland's Dict.*)

They were much used by MEAD and others, and are recommended among other inhalations by Dr. TWEEDIE, in his treatise on Diseases of the Respiratory Organs, as promotive of secretion.

Balsamic inhalations at one time attracted a great deal of attention in continental Europe; they were recommended by DELPIT, RULLIER, MAYGRIER, and others, and very strongly by TROUSSEAU and PIDOUX in the treatment of chronic pulmonary catarrhs, and obstinate cases of chronic laryngitis, especially when connected with ulceration.

The plan advised by Trousseau and Pidoux is to throw some of the balsam upon live coals, which they consider preferable to the method of pouring boiling water upon some of the material in an inhaler, because after their method, the apartment becomes filled with the vapor, and the patient can remain for whole days in an atmosphere thus impregnated. They state that

chronic catarrhs have been cured in this manner after failure with the same remedies used internally.

These inhalations were found valuable in phthisis, as a means of preserving strength, and thus prolonging life. The balsams most constantly employed were benzoin, and, more frequently, balsam of Tolu; and the balsam of Peru was also occasionally employed in the same way.

Inhalation of an ethereal solution of Tolu has been successfully employed by M. Roziere in cases of bronchial catarrh, loss of voice, and chronic affections of the chest generally. His plan is to mix 20 grammes of the balsam with 60 grammes of sulphuric ether; the mixture to be placed in a wide-mouthed bottle which the patient holds, uncorked, to his nose for two or three minutes every half hour.

As, however, the inhalation of sulphuric ether alone, as mentioned previously, is very highly recommended in these very affections, it is not improbable that much of the beneficial effect of the ethereal solution of Tolu is attributable to the menstruum.

To employ the balsams with the ordinary inhaler, boiling water may be poured upon one or two drachms of the drug.

The balsam of copaiba has been much used in inhalation by Dr. EDWARD J. COXE, of Baltimore, in the treatment of chronic laryngeal and bronchial affections.

### *Inhalations of Vapors of Turpentine.*

Professor SKODA has treated gangrene of the lung successfully by turpentine inhalations. His plan is as follows: The essence of turpentine is poured upon boiling water and the patient is directed to inhale the vapor

arising therefrom for fifteen minutes every two hours. Sulphate of quinia is also administered in the usual doses. Four cases are reported (*Medical Times and Gazette*, April 15, 1853; and *Zeitschr. für K. K., Gesellsch. der Aerzte zu Wien.*, 1853, t. ix, p. 445). The first case was that of a servant affected with limited gangrene of the superior lobe of the right lung. After six weeks of this treatment, it became impossible to detect either infiltration or gangrene of the organ. On the contrary, the respiratory murmur had returned over the whole region. Three months afterwards the patient was seen in good health.

In the second case, an innkeeper, of mature age and strong constitution, became the subject of a gangrenous cavity in the lower lobe of the right lung, consequent upon disease commencing March 11, 1852. On March 21st, the patient began with the inhalations of the vapor of turpentine; he continued, without repugnance, for five or ten minutes every two hours, taking, at the same time, the usual doses of quinia. At the end of three weeks, the expectoration, which had been extremely abundant (a pint and a half daily), became reduced to a quarter of a pint. The inspirations had been employed four times a day. At the end of six weeks the patient could quit his bed. His strength was returning, the appetite was improving, and his general aspect favorable; but the expectoration continued to be fetid from time to time, and was always sanious. The right side of the chest was painful, and respiration labored, but the air entered the circumference of the lower lobe; the respiration being uncertain and accompanied by feeble râles and sibilance. The patient went into the country, where he continued the turpentine inspirations



twice a day up to the middle of July, when both cough and expectoration had entirely disappeared. In the month of December, 1852, he came to M. Skoda for a certificate of health. There was no pain, nor oppression, nor cough. He had recovered his *embonpoint* and his strength; there was no retraction of the thorax; vesicular respiration everywhere.

In the third case it was not in the Professor's power to persist in the plan.

The fourth case was still under treatment. A butcher, of strong constitution, had a gangrenous cavity in the inferior lobe of the left lung. He fell ill about the end of May, 1852. The inspirations of turpentine were commenced June 4th. At the end of a week, the fetid expectoration, which daily equalled two pints, had entirely disappeared, and the patient considered himself well, because the pain and the oppression in breathing had diminished, the appetite had returned, and the sleep was tranquil. He therefore left off inhaling the turpentine, which was extremely disagreeable to him. On June 19th there came on a severe shivering fit, with cough and dyspnœa, and during the following night the patient expectorated several pints of extremely fetid sanies of dirty brown color. The inspirations were recommended, but the patient used them as little as possible, on account of the irritation which they produced in the air-passages. In eight days the quantity of matter brought up had greatly diminished, and the pulse was normal, but there was pain in the chest. The patient lay immovable upon his back in a state of great weakness and prostration; there was no appetite. The lower lobe of the left lung was impervious to air. The inspira-

tions were again suspended, but again recommenced on account of recurrence of the bad symptoms, the disagreeable odor of the turpentine being partly rectified by a few drops of the essence of rose. About the middle of October he was able to go into the country, having recovered strength sufficient to leave his bed; nevertheless, there remained a sense of oppression and pain under the left scapula. At the end of January he considered himself well. There was a sudden expectoration of two ounces of blood, after a slight fit of coughing, on February 10th, probably proceeding from the callous walls of a former gangrenous cavity; but there are no signs of further infiltration, and the case seems likely to terminate well (*Ranking's Abstract*, 1854, vol. 19, p. 69).

The inhalation of the vapors of turpentine has also been recommended as a remedy in whooping-cough (*Schmidt's Jahrbücher*, 1866; Band 130, p. 63).

The oil of turpentine may be inhaled by putting 20–60 drops in an ounce of water and applying heat.

### *Inhalation of the Vapors of Tar.*

Sir ALEXANDER CRICHTON published, in 1817, “An account of some experiments made with the vapor of boiling tar in the cure of pulmonary consumption,” in which he explains that accident led him to the discovery of this potent remedy, which he placed before the notice of the profession.

Drs. BLUHM and VON ROOS, reporting upon the value of these inhalations, state, as the result of the study of many cases, that the tar fumigations produce a very prompt and salutary effect upon the cough, the expect-

toration, and the respiration; and that the sleep becomes more tranquil, continuous, and restorative; and that the patient thus regains strength. (Coxe, *op. cit.*)

The tar recommended by Sir Alexander Crichton is that used for the cordage of ships, to every pound of which he added half an ounce of the subcarbonate of potassa, in order to neutralize the pyroligneous acid.

He placed the vessel containing the tar over a spirit-lamp, taking care that it should boil slowly and not burn; the tar being renewed every three hours, so as to keep the apartment impregnated with the vapor night and day. The vessel must be cleansed daily to prevent the incineration and decomposition of the residuum, which is irritating.

These fumigations were not employed alone, other remedies being employed as deemed advisable.

Dr. MACKINTOSH (*Practice of Physic*) recommends the inhalation of the vapors of tar in chronic uncomplicated bronchitis.

Dr. EBERLE recommends the fumes of tar in whooping-cough.

Dr. M. BAILLIE, of London, attests the value of inhalations of vapors of boiling tar and vinegar, in tonsillitis, and similar affections.

Dr. MORTON, of Philadelphia, employed inhalation of tar vapor extensively as a palliative in consumption, and preferred it to any other method of treating chronic catarrh.

Prof. WOOD (*Therapeutics*, &c., 2d ed., vol. i, p. 78) has witnessed the happiest effects from the vapors of tar, when continued for months, in very threatening chronic pulmonary disease.

I have frequently seen benefit from the vapors of tar

in cases of advanced phthisis, and in chronic bronchitis, where, if it has no other local influence, it at least reduces the irritability of the mucous membrane, checks hypersecretion to some extent, and facilitates expectoration, thus conserving the powers of the patient. In recent inflammations, and in the hectic fever of phthisis, its use requires caution, as it has been said to induce congestion, and may thus give rise to hemorrhage or severe inflammation.

Prof. CHAPMAN found benefit from the fumes of concentrated pyroligneous acid in foul ulcerations of the throat and nostrils (*Therapeutics*, vol. ii, p. 36).

#### *Inhalation of Vapors of Creasote.*

Creasote may be inhaled in the proportion of three to fifteen drops to the ounce of water, heat being applied; or it may be employed alone at ordinary temperatures. It may be inhaled from any of the inhalers; or very simply, by pouring boiling water over a few drops of creasote in the bottom of a teapot, and inhaling through the spout.

Creasote inhalations will, it is said, often relieve the irritating cough of phthisis, after the failure of opiates and like remedies, allaying the irritation, checking the secretion, assisting expectoration, and thus acting beneficially by conserving the patient's strength, preventing exhaustion from paroxysms of severe cough, &c., even if it has no specific remedial agency.

Inhalations of vapors of creasote are reported to agree usually very well from the first; but in irritable constitutions, where they are not so readily tolerated, it has been recommended to subdue the irritability of the mucous membrane, by a previously instituted inha-

lation of the vapor from conium ; and where there is any tendency to spasm, to add a few drops of the liquor potassæ at the moment of employing the inhalation.

Dr. ELLIOTSON (*Med. Chir. Trans.*, vol. xix, p. 217) records that in phthisis, he has, in many instances, caused patients to breathe for four or five minutes at a time, and four or five times a day, a mixture of creasote with mucilage and water, but without any decided result. He has found such inhalations useful, however, in cases of bronchitis with profuse discharge, those designated as bronchorrhœa ; he has also found them useful in asthma ; and so also in chronic affections of the larynx, trachea, and bronchi generally, he has found them of great advantage, both when used alone, and when conjoined with other medications ; and he has not known any inconvenience to have resulted from their employment in a single instance.

MM. SERRES and ANDRAL, in their report read at the *séance* of the Académie des Sciences, Nov. 30th, 1857 (*Gazette Hebdomadaire*, Dec. 11th, 1857), upon fumigations of acetic acid and creasote in the treatment of chronic bronchitis, recommended by M. L. MANDL, state that the varieties of bronchitis for which this treatment is recommended are, the dry catarrh of Laennec ; chronic bronchitis with unilateral subcrepitant râle ; and the bronchitis of pleurisy. These three varieties form a group which is designated by Mandl under the name of *bronchite sèche*, characterized by the paucity of symptoms furnished by auscultation and percussion. The treatment consisted simply in the employment of warm fumigations by means of an apparatus composed of a glass globe with double tubulure, furnished with a rubber tubing, and placed upon a copper stand. Into

the vessel is introduced 60 grammes of water, and 5 grammes of a solution composed of 5 grammes of creasote, 50 grammes of acetic acid, and 500 grammes of water. The liquid is then heated, and the fumes that arise are inspired by the patient. The strength of the mixture is to be gradually increased, according to the duration of the malady, the susceptibility of the larynx, and bronchi, &c. Chronic mucous catarrh will not yield to the acid fumigations as readily as the dry bronchitis. In such cases he employs the emetics in addition, repeated whenever indicated by the abundance of râles. In the pituitous catarrh, properly so called, so frequently connected with an affection of the heart, and which in all cases, especially when it has existed several years, denotes a considerable degree of alteration of the mucous membrane of the bronchi, the acidulated fumigations, if well supported, will ameliorate the condition of these tubes, but will not cure them.

*Inhalation of Vapors of Oleum Pini Pumelion.*

LEWIN (*op. cit.*, p. 207) speaks of the use of the ol. pini pumelion, with a few drops of which he saturates a small piece of cotton, which is then placed in the bowl of a small smoking-pipe, through which the patient inspires for several hours at a time. This oil, he states, contains less resin than the ol. terebinth., and is not unpleasant to the taste. The breath and urine soon acquire its peculiar odor, proving its absorption. It seems partly to induce contractility of the sluggish and relaxed vessels, and partly to act as an excitant and expectorant to the mucous membranes. More than from three to five drops are not to be given in a single day, because a larger quantity may become too stimu-

lating. Dr. Lewin has employed such inhalations with success in chronic pulmonary catarrhs, and in pulmonic blennorrhœa; and Dr. BoER recommends its loosening effect from the relief experienced by himself in a tight catarrh. It was at a much earlier date employed by COPLAND in bronchitis, and recommended by him.

*Inhalation of Vapors of Oleum Pini Sylvestris.*

Quite recently (Lewin, *op. cit.*, p. 208), Prof. GERHARDT, of Jena, has made some investigations into the action of the ol. pini sylvest., in chronic affections of the respiratory organs. Into a basinful of hot water he drops from six drops to two teaspoonfuls of the oil, and the patient breathes, through a tube, the vapor that is given off, from half an hour to two hours daily. The effect of this inhalation is found to be very similar to that produced by the oil of turpentine, only that the latter is rather more antiseptic, and the former more astringent and sorbefacient. The best results were obtained in chronic catarrh of the larynx or bronchi, and also in dilatation of the minuter bronchi, one case of which was so far relieved after four weeks' inhalation, that the lessening of the calibre of the bronchi was noticeable, and the expectoration, which previously had been profuse, decreased in quantity, and eventually ceased; while an inhalation of sal-ammoniac instituted earlier had been followed by hardly any result.

The inhalations of the oleum pini were not always well borne, but in the majority of cases, soon produced a decreasing effect upon the amount of expectoration.

*Inhalation of the Resinous Vapors of the Coniferæ.*

Dr. W. W. IRELAND (*Edinburgh Medical Journal*, Feb. 1864; *British and Foreign Med. Chir. Review*, July, 1864, p. 250) had already made the observation that in pine forests, the quantity of ozone in the air was increased by their resinous emanations, which contained, if not ozone itself, at least a substance possessing many of its properties. He records some practical observations made at a little town called Die, in the south of France, on the therapeutic effect of resinous vapors. This kind of treatment was in popular use among the mountains of Dauphiné for more than a century, and was discovered by accident. Some laborers were cutting wood for preparing pitch, when one of them was suddenly seized with acute rheumatism in the legs, which disabled him from the more active work, but allowed him to arrange the cut wood in the furnace. After working a little time at this employment, which exposed him to the resinous vapors from the wood, he felt his complaint gradually disappearing; and the cure thus effected became known among the peasantry, and subsequently attracted more particular attention.

Dr. CHEVANDIER, finding that the peasants suffering from rheumatism exposed themselves to the vapors of a pitch furnace, and thus became cured of their complaints, examined the subject in a scientific manner. He found that the peasants had been in the habit of sitting in the furnace at a heat of nearly 190° Fahrenheit, and his own experience showed that in an atmosphere saturated with turpentine vapors, that very high temperature was not only tolerable but pleasant, and he himself entered the furnace to study its physiological effects. He



found that the skin perspired freely, the pulse rose, and his sensations were agreeable.

Since these experiments were made, some baths have been used at Die, on the same principle as the pitch furnace. They resemble a large baking-oven, the fire being below; and the resinous layers of pine wood are strewed upon the floor, and the patient sits upon a bench, wrapped in a porous covering of wool.

The temperature to which the patients are exposed is generally from  $140^{\circ}$  to  $158^{\circ}$  Fahr., and they remain from fifteen to twenty minutes. The sensations of the patients are agreeable, and the perspiration is abundant, the pulse rising from twelve to fifteen beats, and at first the respiration is accelerated. After the proper period has expired, the patient goes to bed, where he remains an hour or two.

The diseases treated by this plan are rheumatism in all its forms; inflammation of mucous surfaces, as chronic bronchitis and laryngitis; neuralgia; glandular enlargements; and constitutional syphilis. Nine-tenths of the patients who come to Die suffer from rheumatism, the muscular form yielding more readily than any other, but articular rheumatism yields more slowly. After rheumatism, chronic bronchitis appears to be most benefited by this treatment, probably from the effects of the vapor on the diseased mucous membrane. Five cases of phthisis are also said to have been successfully treated by courses of twenty baths, but most of the cases were in the first stage.

Pectoral complaints never occur among those who work in turpentine, and in the south of France it is known that these maladies and rheumatism are comparatively rare among the inhabitants of districts covered

by pine forests ; and hence it would appear that the resinous vapors possess some important therapeutic properties in these diseases.

Dr. IRELAND suggests that the beneficial effects may be due to the influence of ozone or antozone upon the blood. Hence, fumigations of the resinous layers of fresh pine wood, or of oil of turpentine, may be beneficial in phthisis, or the patient may live in a room or conservatory filled with saplings of pine.

Baths, like those used at Die, have been attempted in other places, as at Grenoble, Valence, and near Vaucluse, but the wood the inhabitants employ is said not to be the same ; and Dr. Ireland recommends patients laboring under obstinate rheumatism or bronchitis to go to Die, which is reached by a diligence, starting from the railway station at Valence. Die is a small town, situated in a beautiful valley among the Alps of Dauphiné, the lofty peaks of which guard it from the mistral, and its elevated situation saves it from the scorching heat of the summer of the South.

Inhalations of the vapors of resin have been employed under the same circumstances as the vapors of tar, turpentine, creasote, &c., and the well-known effect of such inhalations has prompted the practice, which is of very ancient origin, of sending patients affected with phthisis and other chronic pulmonary affections, for temporary or permanent residence, to regions in which pine forests abound.

Also the fumes from burning undressed wool have been recommended in cases of chronic laryngitis and bronchitis, and they have also been said to prove advantageous in phthisis.

It may be remarked in connection, that the assertion

has been made that young persons employed in wool-factories are exempt from phthisis, in consequence of the constant exposure to the inhalation of oil, which is used in large quantities in such factories.

*Inhalation of Permanganate of Potassa with Vapor of Water.*

Staff-Surgeon Dr. THALWITZER, of the Prussian army, during the recent war with Denmark, employed inhalations of permanganate of potassa with vapor of water in two cases of severe dyspnœa, consequent on gunshot wound of the chest. Five grains of the permanganate of potash were added to the water inhaled at each sitting. The instrument employed consisted of a tightly-closed cylinder with a funnel-shaped cover, the tube of which, after rising for a foot, was bent at an angle and then continued horizontally for another foot in length. In both cases the expectoration became decreased, and in one case, in which pulmonary gangrene had ensued, the foul odor was markedly reduced. Both patients liked the inhalation, which relieved the difficulty of expectoration and improved their general condition. (*Schmidt's Jahrbücher*, 1866 ; Band, 130, p. 140.)

*Inhalation of the Vapors of Nitrate of Potassa.*

Inhalation of the fumes from burning nitrate of potash have been much lauded in cases of asthma. Pieces of bibulous paper are soaked in a saturated solution of the nitrate and then dried. When used, the paper is set on fire in a convenient vessel and the patient inhales the fumes as they are given off, or merely breathes the air of the apartment. Sometimes they are smoked in a pipe in the same way as ordinary tobacco. They have also

been employed in whooping-cough and in the spasmodic coughs attendant upon other affections. Recently they have been much recommended by Dr. Hyde Salter, in the treatment of asthma.

*Sal Ammoniac—Muriate of Ammonia.*

This substance has been recognized as a beneficial agent in the treatment of affections of the throat and respiratory organs, from the very earliest periods in the records of medicine.

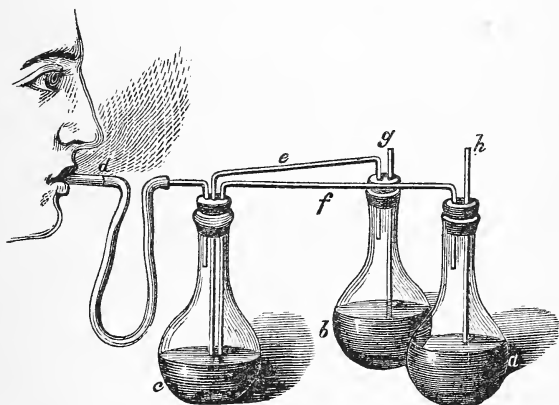
It was first employed by inhalation, according to Lewin, by a pupil of the famous Prof. Schönlein, Prof. FUCHS, of Göttingen. In the published report of the Göttingen Clinics for 1838 and 1839, it is recorded that Prof. Fuchs employed the inhalation of the vapors from sal ammoniac in the treatment of chronic catarrhs of the respiratory organs, placing the material upon a heated porcelain plate, and directing the patient to breathe the fumes. LASSEQUE, more recently, resorted to the same means, in France, with satisfactory results. Later, in 1855, the fumes from sal ammoniac were highly recommended by Dr. GIESELER in chronic pulmonary catarrh, and his method of administration is as follows: Two or three teaspoonfuls of the salt are placed in a Hessian crucible and heated over a Berzelius lamp, the patient sitting in front of the apparatus and inhaling the vapor; the chamber soon becomes filled with the fumes of sal ammoniac, and for some time after their disengagement has been discontinued, the invalid remains in the strongly-impregnated atmosphere.

Direct inhalations give better results than breathing the strongly-impregnated atmosphere of a room in which the fumes are being disengaged. Paroxysms of cough,

with profuse expectoration, ensue only during the earlier sittings; later, there results merely a sensation of warmth in the air-passages.

LEWIN, of Berlin, devised a chemical process for procuring the vapors of sal ammoniac in a nascent state without the employment of heat or fire, which latter method, besides being inconvenient, evolves the fumes too rapidly and too profusely, thereby filling the chamber with the fumes, and often provoking cough, &c.

FIG. 12.\*



Lewin's apparatus for the inhalation of vapors of sal ammoniac. (From *Lewin*.)

This apparatus (Fig. 12) consists of a series of three Wolfe's bottles. One of these contains liq. ammoniæ caustici, another pure muriatic acid, and the third bottle,

\* *a*, glass vessel containing strong aqua ammoniæ; *b*, glass vessel containing muriatic acid; *c*, glass vessel containing distilled water, slightly acidulated; *d*, rubber tubing, to which is attached the mouth-piece; *e*, *f*, connecting glass tubes; *g*, *h*, glass tubes for admittance of atmospheric air.

which is filled with water, receives a tube from each of the other bottles, these tubes reaching to the bottom of the water, while from a third opening in the cork the vapor extrudes through an exit tube, to which a mouth-piece is attached by India-rubber tubing. Now, as the effort of inspiration draws the liquids from the first two bottles into the third bottle, their ingredients combine to form the sal ammoniac vapor, which, during its passage through the water, becomes cleansed of impurities. If it is desired to medicate the nascent sal ammoniac with creasote, or an oleo-balsamic mixture, or bitter almond water, &c., all that will be necessary, will be to add it to the water in the third bottle.

Dr. PASCH (*Preuss. Vereinzeitung*, 1862, 19, quoted by Lewin, p. 200) places a drachm of liq. ammon. caustici in a saucer, in which he places a watch-glass containing ℥j—℥ss of pure muriatic acid. White fumes of sal ammoniac are immediately evolved, and, as in other cases, may be inhaled with or without the use of a funnel, to direct them into the mouth. A great excess of ammonia is produced by this method, but it is not considered injurious. There always remains a quantity of carbonic acid gas in the lungs of catarrhal patients which is not exhaled, and which, remaining in the minutest bronchi, becomes converted into carbonate of ammonia as the sal ammoniac reaches it.

I have often instructed patients merely to place a pinch of the salt upon an iron spoon and hold it over the flame of a gas or spirit-lamp; the fumes are evolved in a few moments, and the spoon can be removed and the fumes inhaled until evaporation ceases, when the process is to be renewed until the required amount has been employed.

I can testify to the extreme value of these inhalations in cases of dryness of the fauces, even when of several years' standing, as met with in salesmen and others, whose mouths are more or less frequently open, and who, by the nature of their employment, are exposed to variations of temperature; also in the dryness of the fauces of cooks, bakers, and others who are constantly breathing a heated atmosphere; also in chronic pharyngitis; in the commencing stage of bronchitis, to induce free secretion; in snuffles, naso-pharyngeal catarrhs, &c.

*Inhalation of Vapors from Opium, and other narcotics.*

Opium, as is well known, is extensively inhaled in the East for sensual purposes. The Chinese place a portion of the extract, the size of a pea, into the bowl of a pipe, which is heated over a flame for a time, and then the opium is set on fire and the smoke forcibly inhaled.

Dr. SNOW's method is to place the required quantity of the extract, in the form of a pill, upon the capsule of his inhaler, described on pages 179 and 180, and then the spirit-lamp is lighted beneath; the patient beginning to inhale immediately, and continuing to do so until volatilization ceases, the process usually lasting about ten minutes, and leaving as residue a porous carbonized mass.

Morphia, in doses of half a grain, may be used for inhalation in preference to opium, than which it is said to be pleasanter, inasmuch as the extract of opium supplies some smoke in addition to its active principles. The morphia is mixed with dry plaster of Paris to increase its bulk.

Extract of stramonium has been used by inhalation in the same manner as extract of opium, in cases of asthma, and with asserted relief.

Inhalation of vapors of stramonium was first introduced by Ziegler, and has been highly extolled by Martin Solon, Andral, Trousseau, and many other Continental authorities. It has been employed a good deal in this country, though not much positive information has been recorded. These vapors are also said to give relief in the exhausting cough and impeded respiration of phthisis; and in dyspnoea from any cause.

The dried leaves, or the fibres of the root may be smoked, alone, or with tobacco if the patient is accustomed to tobacco, either in a pipe, or a cigarette; or cigars may be steeped in a strong decoction of stramonium and then dried until fit for smoking.

As ordinarily smoked, it is doubtful whether the remedy gains access into the lungs, but if the smoke, as it issues from the mouth after the puff of the smoker, is inspired, it will then be drawn into the lungs and the effect will be more prompt; otherwise it does not enter the larynx, and the effect is due to absorption by the mucous membrane of the mouth and pharynx.

Belladonna, employed in a similar manner, has been recommended by many of the same authorities for the cure of spasmodic asthma; it is sometimes mixed with tobacco and smoked, and sometimes the vapor from an infusion in water is inhaled.

Other narcotics have also occasionally been employed by inhalation for similar purposes.

#### *Inhalation of Camphor.*

This substance was probably first employed by inha-



lation by the Arabian physician AVICENNA. In the form of vapor, camphor is sometimes inhaled in asthma, croup, spasmodic coughs, and chronic catarrhal affections; and there is no doubt that its constitutional impression may be obtained in the same way. It may be inhaled by means of an ordinary inhaler, placed in water more or less heated, to favor the volatilization of the camphor.

M. RASPAIL recommends that a small tube, a quill, for example, should be filled with the coarsely-powdered medicine, and loosely closed at each end, so as to admit the passage of air, and that this should be used in the same manner as a cigar, but without burning. In the inhalation of camphor, care must be taken to arrest the process when signs are exhibited of its acting on the brain.

A piece of camphor held before the nostrils, so that its vapor may be snuffed up into the nasal passages, is sometimes beneficial in coryza. Powdered camphor has been recommended to be used in the same way, and for the same purpose, as well as for the relief of various spasmodic or catarrhal affections of the air-passages. (*Wood's Therapeutics and Pharmacology*, Phila., 1860, vol. i, p. 714.)

A drachm or more of the tincture of camphor may be placed in an ounce of water, and inhaled with the watery vapor evolved by a spirit-lamp.

Inhalations of the vapor of camphor were much employed by Dr. BÖDTCHER of Copenhagen.

The inhalation of vapors of camphor with those of iodine have been used successfully by Prof. A. P. MERRIL, now of New York. (*Memphis Medical Recorder*, March, 1855, p. 228.)

*Inhalation of Tobacco Smoke.*

In those who by habit have not lost their susceptibility to the effect of this plant, the inhalation of the smoke from tobacco will often serve a good purpose in nervous affections of the respiratory organs. It has thus been recommended in ordinary spasmodic cough, in asthma, in phthisis, and also in spasmodic croup.

*Lime Inhalations.*

Dr. A. GEIGER, of Dayton, Ohio, administers lime-water by inhalation,—or rather vapor of water containing small particles of lime in suspension,—by pouring hot water upon small pieces of unslacked lime; the ebullition is such in the process that a profusion of minute particles of the lime becomes detached and forced up with the steam arising from the vessel in which the slacking is going on, and remain with it in suspension, so that the compound can be readily inspired.

Dr. Geiger, after narrating a very interesting case of diphtheritic croup in which large portions of membrane retaining the cast of the entire trachea were coughed up, and a portion of which he found to become dissolved in lime-water (*Med. and Surg. Reporter*, Phila., March 24th, 1866), continues: “I determined to try the effects of the lime in the next case of diphtheria, or pseudo-membranous croup, occurring in my practice. The first case that presented itself was one of croup, in a boy about four years of age (son of Irish parents), residing some two miles from the city. The boy had already been sick two days before my visit. When called, I ordered the father to take out with him some unslacked lime, which he did. Upon my arrival at the house, I

found the patient sitting up in bed ; severe and distressing dyspnœa ; the face and body covered with perspiration from his efforts to get his breath. The usual harsh, dry cough, and the symptoms all indicating the last stages of pseudo-membranous croup, I determined to try alone the effects of the lime, as I saw no hope in any other treatment. But in what way could I bring it in contact with the membranous formation to dissolve it? I hit upon the following expedient: I placed some unslacked lime in a saucer, and then, after throwing a cloth over his head, held the saucer under, so that he was compelled to breathe the fumes arising from the lime in the process of slacking. I retained it for a few minutes and then removed it. The breathing was some easier, and directly he expectorated a large quantity of tough mucus and phlegm, and was very much relieved. In this process, the steam arising from the lime in slacking, contains in it particles of lime which are thus, by inhalation, brought in contact with the membrane in the windpipe. I ordered lime-water and milk to be given internally, and the inhalations to be repeated in the same way, whenever the symptoms of suffocation were severe, and that the father should report to me in the morning the boy's condition.

“He came in the following morning, said ‘he was much better ; that the night before, after again inhaling the fumes of the lime, he had vomited up a lot of tough stuff, and got better right away.’ I prescribed a cathartic to be given him, and the fumes of the lime, if he choked up again. I saw the patient no more. The father reported from day to day that he was getting better, and finally, that he could ‘eat as much as ever.’”

Dr. Geiger, in the same communication, reports

another case of a fleshy little boy, three or four years of age, attacked two days previous to his visit. There was hard breathing, stridulous cough, with evidence of the formation of membrane, though to less extent than the case above. A purge was ordered, and directions given how to employ the lime inhalations. Visiting the child again in a few hours, he found the difficulty in breathing quite relieved; the mother reporting that the lime had acted like a "miracle;" that after breathing the fumes for a few minutes, he vomited freely and was at once relieved. On the day following, the child was so well that further medication was unnecessary.

Dr. Geiger also states that Dr. O. CROOK, of the same city, reported six cases of diphtheria and membranous croup, in which the fumes of lime and lime-water were used, five of which recovered.

Dr. Geiger reports another successful case in the same journal for March 10th, 1866.

Dr. ALEXANDER J. C. SKENE, of Brooklyn, N. Y., reports (*Med. and Surg. Rep.*, Dec. 22d, 1866, p. 527) that he has tried the inhalation of lime-water broken up into spray by Richardson's Spray Producer, in several cases of croup, and believes that he has observed marked advantage derived thereby.

Dr. THOMAS BYRNES, of Walcott, Iowa (*Med. and Surg. Reporter*, Philadelphia, July, 1866, p. 26), reports a case of diphtheria in a child seven years of age, in which, when he was called to the case, the tonsils were large, and the mucous membrane of a bright red color, a small patch of membrane covering the left tonsil. The constitutional symptoms were very slight. He swabbed the throat with tr. ferri chloridi, and administered five

drops internally every hour. The following morning the tonsils were covered with false membrane, which had ascended to the palatine arches. Small patches were visible on the uvula also. The cervical and sub-maxillary glands had become very much swollen, and painful to the touch. The lime was prepared for inhalation, as directed by Dr. Geiger, and it soon exerted its beneficial effect. Small patches that covered the uvula were entirely dissolved, and those on the tonsils were diminished in size. The inhalations were continued at intervals of four hours. Towards evening, the false membrane had entirely disappeared, but returned again the next day and was again removed by lime inhalations. The systemic affection in this case was combated by supporting measures and the internal administration of iron.

Dr. C. V. MOORE, of Stillwater, New Jersey, writes to the *Med. and Surg. Reporter*, of Philadelphia, September 5, 1866, p. 224, as follows: "I have recently had two severe cases of diphtheria. In one the disease had invaded the larynx, causing loss of voice, croupy cough, and paroxysmal attacks of suffocation and respiration. Both cases were promptly relieved, and cured simply by the internal administration of small and oft-repeated doses of permanganate of potassa, and the inhalation of vapor of slacking lime. The relief from the inhalation was very marked, and the result was gratifying, both to the little sufferer, the friends, and most assuredly to the attending physician."

These cases were sporadic. Internal treatment, milk, and beef tea.

Acting Assistant Surgeon HENRY McELDERRY, United States Army (*Phila. Med. and Surg. Reporter*,

April 28, 1866), reports a case of diphtheria, in which, in addition to supporting systemic treatment, the inhalation of lime with steam, from the action of hot water on unslacked lime, was employed with the successful removal of rapidly-spreading diphtheritic deposit on the left tonsil and on the arches of the palate on that side. He writes that the instantaneous relief given by the inhalations, when he has seen so many remedies signally fail in diphtheria, has led him to attribute the very fortunate and successful issue in this case entirely to their influence. He has never seen any remedy act with more promptness or satisfaction than the lime inhalations did in this case.

Many other cases have been reported subsequently, confirming the statements and experiments of Dr. Geiger.

#### *Inhalation of Arsenical Vapors.*

The vapors from arsenic are known to produce certain poisonous effects upon those unaccustomed to them. They were formerly used in the East for medicinal purposes, and their employment has recently been revived by Trousseau, who employed cigarettes made from bibulous paper saturated in a watery solution of arsenite of soda, ʒss-j to the ounce, in the treatment of chronic bronchial affections, and in phthisis.

#### *Inhalation of Mercurial Vapors.*

The inhalation of mercurial vapors has been employed for ages in Arabia and in India for the production of salivation.

FRACASTORI tells us (*Copland, on Bronchitis*, 1866, p. 133) that inhalations of vapors from cinnabar were

used at a very early date in the treatment of constitutional syphilis.

The vapors from mercurial cigarettes have been used with advantage (*Stille's Therap.*, vol. ii, p. 694) in cases of chronic thickening of the vocal cords, ozæna, nasal polypus, and catarrh of the Eustachian tube; the cigarettes for which purpose may be made according to the following directions, originally suggested by Trousseau: Take nitrate of mercury and strong nitric acid, of each fifteen grains, distilled water a sufficient quantity; mix the acid and water, add the nitrate of mercury, and dissolve by a gentle heat; saturate with the liquid a sheet of thick white blotting-paper, six inches by eight in size, and dry it; before it is entirely dry cut the paper into suitable strips for making tubes about one-eighth of an inch in diameter, and secure with gum; the interior of the tube may be stuffed with tobacco for those who are accustomed to smoking, but this addition it is better to dispense with; the paper, when dry, will burn steadily, and its smoke, on being drawn into the mouth, should be directed upon the seat of the disease.

Dr. POLAK (*Wiener Medic. Wochenschrift*, 1860, No. 36) writes of the mercurial inhalations employed in the Orient for the treatment of syphilis. He says that in Persia the readiest method of curing syphilitic affections is by means of inhalation. There is added to the moistened narghilè-tombac, a trochiscus of cinnabar, and a pipe thus prepared is smoked by the patient once or twice a day.

The ordinary formula for the pastille is as follows: Cinnabar, 2 muskals (1 muskal is equal to 66 grs. apothecaries' weight); catechu, 2 muskals; borax,  $\frac{1}{2}$  muskal; Lawsonia 2 muskals; china nodosa, 3 muskals; com-

bined with mucilage of gum arabic, and formed into 12 troches. Another formula is cinnabar 2 M., mercury 2 M., leaves of cannabis indica 3 M., made with mucilage into 14 troches.

One or two of these pastilles is to be smoked daily, and in the following manner: The smoke is inhaled into the lungs, retained there for a few moments, and then expired either through the mouth alone or through the mouth and nose together. Generally, a moderate mercurial stomatitis ensues after the eighth or tenth inhalation, which is a sign for discontinuing the process. During the treatment the patient must rinse out the mouth frequently, and be careful to observe great cleanliness. The diet consists of milk with sugar, rice and milk with sugar, also sheeps-feet jelly. Salt food, acids and fruits are interdicted. The mercurial stomatitis is treated with powdered sumac, with catechu, or the tabaschis (bambus magnesia) with gulnar (full flowers of the pomegranate). According to these investigations of Dr. Polak, no other method is comparable with that of these inhalations for the prompt treatment of syphilitic affections of the throat.

#### *Inhalation of the Vapor of Chloride of Copper.*

Dr. TH. CLEMENS, of Frankfort-on-the-Main, has communicated several articles to the *Deutsche Klinik*, 1865-6, on the use of the vapor from a chloride of copper by inhalation, and as a disinfectant. He asserts that it is an established fact, supported by experience, that workers in copper mines and in copper fabrics remain protected against the cholera poison. This led him to the employment of these vapors in the treatment of cholera, in connection with the internal and external



use of the remedy. The vapor is produced by heating a solution of the chloride of copper, a drachm to the pound of alcohol, with the addition of two drachms of chloroform. He has used it successfully as a disinfectant in crowded hospitals, and it has proved effectual in epidemics of measles and scarlet fever. He has used the vapor by inhalation successfully in one case of pulmonary gangrene, and in two cases of pulmonary tuberculosis.

*Inhalations as pursued by the Persians.*

LEWIN (p. 209) copies from the *Allg. Med. Central Zeitung*, 1863, No. 23, an interesting account of the method of inhalation pursued by the Persians, as narrated by Dr. POLAK. This consists in smoking the fumes of certain medicinal agents through their narghilè, a smoking apparatus, by means of which the smoke passes through a vessel containing cold water, before it reaches the mouth. The material to be employed medicinally is mixed with their smoking tobacco, which is made into moistened masses and inserted into the plaster bowl of the narghilè, and then burning coals are laid upon it. The material is slowly consumed, and the smoke in passing through the cold water receptacle, is not only cooled, but also deprived of a portion of its narcotic or other properties. Dr. Polak found that the inhalation of cinnabar was very well borne, even by young children; that six to eight strong pulls produced a slight sensation of approaching syncope, continuing, however, only for a short time, and allowing the operation to be repeated by the next day.

In cases of chronic catarrh and bronchitis, Dr. Polak employed gum ammoniac, gum galbanum, &c; in spas-

modic and hysterical affections, assafoetida; in ischias, turpentine with pistacia lentiscus, or mastic, with good results, or at least without injurious effect. In addition they could employ quinine, salicine, even narcotine and digitalis; and many mineral substances, as borax, sal ammoniac, &c.

By smoking the tobacco, a condition of relaxation can be induced, advantage of which may be taken, the same as the narcosis from chloroform, for the reduction of luxations, the reposition of hernias, &c. The plant tombak, employed by the Orientals, is one of the Nicotianæ, and very similar to our own tobacco; it has a red leaf, grows favorably in sandy soils, &c., &c.

#### *Inhalations of the Vapor of Hot Water.*

Inhalations of the vapor from hot water are very serviceable in many states of laryngeal inflammation, especially in cases of croup, where the supply of watery vapor perhaps prevents the congelation of pseudo-membrane, and keeps the exudation in a fluid state, and thus more readily expectorated.

It is not improbable that all the benefit from the inhalation of warm lime-water in croup acts in this way, affording moisture to the exuded matters, which in their congelation must part with some of their watery constituents.

After the performance of the operation of tracheotomy, it has been found serviceable to maintain a warm and moist atmosphere about the patient.

It is well known that in many pulmonary complaints, accompanied with more or less distress in breathing, advantage will follow the warming and moistening of the air by keeping a current of steam rising from a

vessel of water kept boiling for that purpose. The warm moisture inhaled acts upon the irritated membranes with the same soothing influence exerted upon external inflammations by warm fomentations, and thus the disposition to cough is lessened, expectoration is facilitated, &c.

Warm steam, with camomile flowers and a little ether has been recommended in asthma by Dr. EBERLE, and also the inhalation of vapor of warm water and vinegar, in cynanche tonsillaris, and tracheitis.

Dr. MACKINTOSH recommends the inhalation of hot vapor in croup, and in scarlet fever.

The vapor of medicated waters may be employed medicinally by inhalation; thus, BOERHAAVE employed the vapor of water distilled over elder flowers, as a remedy in pulmonary catarrh.

The vapor from vinegar thrown upon hot water, facilitates dislodgement of mucus, which can then be more easily expectorated. The vapor of vinegar with boiling tar, was employed at one time by Dr. M. BAILLIE, of London, in chronic pulmonary complaints. Dr. PRINGLE (E. J. Coxe, *Treatise on Inhalation*, Phil., 1845) attested the good effects he had observed in pleuritis and pneumonia from causing his patients to breathe over the steam of hot water, a practice recommended by BOERHAAVE and VAN SWIETEN, and confirmed in repeated trials by Dr. HUCK, who found it more beneficial when the phlegm was viscid, as also more grateful to the patient by adding a small portion of vinegar; and Dr. RUSH, in editing Dr. Pringle's work, says that too much cannot be said in favor of this simple and powerful remedy, for he has seen patients snatched from the jaws of death by it.

Dr. TWEEDIE (*Dis. of Resp. Organs*) says the inhalation of steam in some cases rendered slightly stimulant and alterative by the addition of camphor, turpentine, or the balsams, has been found useful in promoting secretion from the diseased membrane. He recommends also, the use of sedatives, and antispasmodics, as belladonna, camphor, ether, and opium, by inhalation in chronic laryngitis.

Dr. EBERLE recommends warm steam, with camomile flowers and a little ether, in asthma; warm water and vinegar in cynanche tonsillaris and trachealis.

WINTERINGHAUSEN, though disapproving of fumigations as advised by Bennet, Mead, and others, acknowledges the advantages derived from the inhalation of the steam of hot water, medicated vinegar of squills, &c.

The value of inhalations of steam in cases of poisoning by corrosive vapors is submitted to the profession by SAMUEL P. DUFFIELD, Ph.D., who in the *Detroit Review of Medicine and Surgery*, gives the following successful treatment of poisoning by bromine inhalation: The corrosive action of the bromine was such that the glottis had closed with a spasm, and did not yield willingly. The patient was brought near to a steam-pipe, the mouth held open, and the steam thrown from some distance, so as not to burn him, into his mouth and over his face. It had the desired effect, and the patient was subsequently sent home. The steam inhalations were continued for some time, and the patient recovered. (*The Medical Record*, New York, Sept. 16th, 1867, p. 323.)

### *Medicated Atmospheres.*

In addition to the methods of direct inhalation, in-

direct inhalations have often been employed, by medicating the atmosphere in which a patient usually resides, as has been alluded to incidentally. The method has been at several times resorted to as a regular curative process in the treatment of chronic pulmonary affections. BARTOLINUS endeavored in this way to keep sitting apartments medicated with vapors, as substitutes for voyages to special climates, for those unable to leave their homes.

THOMAS BEDDOES recommended that the apartments usually occupied by consumptives should communicate with cow-houses, stables, &c., so that the atmosphere should be continually impregnated with the warm ammoniacal emanations; and this plan of treatment was at one time considered highly successful, but it soon fell into disrepute, and subsequently into disuse. Thus, also, residences near tanneries, have at various times been recommended for the purpose of supplying an atmosphere more or less constantly impregnated with vapors which have been considered remedies of great value in the treatment of pulmonary affections.

While this work was in press, I received, too late for incorporation in a more appropriate place, a letter from Dr. S. WATERMAN, Surgeon to the Metropolitan Police, New York, in which he speaks very highly of *aromatic alcoholic inhalations*. He says: "I have been in the habit for many years of making use of aromatic alcoholic inhalations, and I have no hesitation in saying that they are of the most signal service when properly employed. I have used for this purpose the best 'eau de cologne,' that of Maria Farina, which I mix in teaspoonful quantities with boiling water on the stove in winter, and on a gas-stove in summer. It creates an atmosphere highly impregnated with the aroma of the

volatile oil contained in the preparation, and is willingly inhaled by the patient. I have used these inhalations,

“1st. In the more advanced stages of croup, when from the imperfect decarbonization of the blood the nervous powers begin to fail, and paralysis of the nerves of the lungs is to be feared. In this state the inhalations act as a local stimulant, invigorating the nervous power, and often overcoming that dangerous state when no other remedy would do so. That these inhalations exert, also, a beneficial effect upon the nervous distributions of the entire mucous membrane of the fauces, larynx, trachea, and bronchi, in these cases, I now entertain no matter of doubt.

“2d. In bronchial disorders dependent upon a relaxed state of the mucous membrane, these inhalations have often proved highly useful. For adults they may be continued for days and weeks. They sometimes cause violent cough; but it is just in such cases, where they exert a stimulating effect upon the mucous surfaces, that their effects will be found salutary.”

### *Respiratory Diet.*

In 1848, SALES-GIRONS suggested the regularly supplying diseased lungs with a respiratory pabulum, suitable to their condition, on similar grounds to those defining suitable diet in diseases of the digestive organs, and this he called a respiratory diet. A piece of resin or balsam, or whatever was intended to medicate the air, was placed within a respirator, to be worn in front of the patient's mouth, thus keeping him in the same atmosphere all day long, and enabling him to attend to his business without exposure to the unmitigated oxygen of the atmosphere, often prejudicial in many diseases of the pulmonary organs.

He maintains (*Gazette Hebdomadaire*, February 17, 1860, p. 108) that respiration is susceptible of diet as easily as digestion; and for the purpose of supplying this diet, he employs various substances, placed in a little apparatus, which the patient carries about him the greater part of the day, applied above the mouth and nostrils, to modify the atmosphere before it gains access to the respiratory tract. He contends that the respiratory diet is in accordance with a theory of relations between the living organism and the atmosphere, or the theory of relations of the lungs with oxygen.

In the discussion which ensued upon Bouillaud's report upon the work of Sales-Girons (*Gazette Hebdomadaire*, January 4, 1861), M. Fontan put the query whether there was not in this production of Sales-Girons, the germ of a grand discovery, that of a third state of oxygen, oxygen negatively electric, or sub-oxygen, in contradistinction to oxygen positively electric, ozone or sur-oxygen, and ordinary oxygen, or neutral oxygen.

Prof. DICKSON (*Elements of Medicine*, 1855, p. 624) says we would anticipate some soothing influence from the inspiration of air made to contain a less quantity of oxygen, which is generally regarded as a stimulant. He refers, however, to atmospheric mixtures with nitrogen and hydrogen, and with carbonic oxide or carbonic acid; and accounts in a similar way for the advantages said to have been derived by some consumptives, from residing in stables with cattle, so much in vogue in England in the time of Darwin and Beddoes.

This method of keeping up a peculiarly medicated atmosphere is much the same as Sales-Girons' respiratory diet.

# ON INHALATION.

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## PART III.

### THE INHALATION OF POWDERS.

#### CHAPTER I.

##### THE INSUFFLATION OR INHALATION OF POWDERS IN AFFECTIONS OF THE RESPIRATORY ORGANS.

THE earliest employment of powders by insufflation, in the treatment of diseases of the air-passages, has been ascribed to *ÆSCULAPIUS*, who, according to *GALEN*, was accustomed in cases of angina to blow an astringent powder into the larynx by means of a bent reed.

*ARETÆUS*, who flourished in Cappadocia in the latter part of the first century, is said to have used a similar instrument and for the same purpose, especially in the laryngeal complaints of children; while in our own days, the method has been reintroduced into practice by *BRETONNEAU*, *TROUSSEAU*, and *BELLOC*, followed by many others, who have devised instruments of various form and mechanism for the propulsion of such powders. *Trousseau's* instrument consists of a glass tube of con-



venient size, within one aperture of which is to be inserted from three to four grains of the powder to be used; the other end is placed as far as possible within the mouth of the patient, who closes his lips upon it and takes an inspiration through the tube. Trousseau recommends the medicinal powders to be rubbed up with sugar of milk, to give them sufficient body. His formulæ are, for bismuth, 1 part to 1, 2, or more of the sugar of milk; for alum, 1 part to 2; for acetate of lead, 1 to 7; for calomel, 1 to 12; for red precipitate, sulphate of zinc, and sulphate of copper, 1 to 36; for nitrate of silver, 1 to 24-72. He employed the alum and bismuth in relaxed conditions of the mucous membrane, unattended with marked inflammation; the salts of lead and copper, in cases of considerable inflammation; nitrate of silver, in cases of known or inferred ulceration; the mercurial preparations, in syphilitic cases, and also in non-specific ulcerations. The insufflations were made daily, or every other day.

Prof. BUROW, of Königsburg (*Deutsche Klinik*, 1853, No. 21) was in the habit of employing in this manner, nitrate of silver, three grains to the drachm of sugar of milk, in chronic laryngitis; and reported a number of cases of several years' standing, with almost complete aphonia, which were cured in a few weeks, with restoration of the voice even to purposes of vocal music. Finding with many of his patients an inability to inhale the powder by the methods previously recommended, and that in some cases the powder was actually blown out of the tube in expiration, he devised a special contrivance, composed of two parallel tubes, one furnished with a valve, so that the powder could not be blown out by expiration, but was compulsorily inhaled

in inspiration. The quantity of the powder employed by him was as much as could be put in the nib of an ordinary steel pen; and this amount was used daily.

PSEPHOFER, of Vienna, treated not only laryngeal, but also bronchial and pulmonary troubles in this way, and also employed the respiratory tract for the introduction of medicines in the treatment of affections of other organs (*Schmidt's Jahrb.*, 1856).

EBERT, of Berlin, placed the powder in a steel pen, which he placed half-way within a quill open at both ends, and inserted the quill within the mouth in such manner that the pen should lie over the root of the tongue, when the patient, closing his lips over the quill and compressing his nostrils, inhaled suddenly and strongly. He found the patients' first attempt usually unsuccessful, the powder only getting upon the base of the tongue and about the pharynx, so that when nitrate of silver was used, the peculiar metallic taste was perceived in these parts; but generally after the second or third attempt, the powder was more or less thoroughly inhaled, as evinced by spasm of cough, burning sensation in the larynx, &c. A number of cases of laryngitis are narrated, some in young and delicate females, in which satisfactory beneficial results followed this treatment. For details of twelve cases, see Lewin, *op. cit.*, p. 126 to 136.

LEWIN, of Berlin, uses a small tubulated retort for the inhalation of powders, a small tube passing through the stopper to the bottom of the retort in which the powder is placed, the patient inspiring forcibly through the beak of the apparatus.

The most convenient insufflator that I know of is that of Rauchfuss, which consists of a properly shaped

tube, with a gum ball for the purpose of propelling the powder forwards; the powder is inserted into a slot in the tube, over which a smaller tube slides after the introduction of the medicine, which can be propelled in any direction desired, by arranging the apertures of exit at the distal extremity of the tube.

Chambers, Fournié, and many others, have devised instruments for this purpose.

Dr. T. K. CHAMBERS, of London (*Lancet*, 1848), recommends the inhalation of a light innocuous powder, with which the required medicinal agent may be mingled. He found most suited to his purpose the pollen of the lycopodium (club-moss), first allowed to imbibe as much as it would take up of a saturated solution of the substance to be employed (in the cases narrated, nitrate of silver and sulphate of copper, or a combination of the two), and then carefully dried, and afterwards reduced to an impalpable powder. The plan recommended for the inhalation is, that the patient should introduce into his mouth, as far as may be without choking, the tube of a well-dried glass funnel, and draw in his breath strongly at the same moment that an attendant, or himself if able, dusts the powder into the funnel from a nursery puff-ball. To obviate the necessity for withdrawing the funnel during expiration, and to prevent the powder from floating about the room, an apparatus with a double valve, and a closed powder-box allowing the powder to pass only from without inwards, may be employed instead of the funnel.

Prof. DICKSON (*Elements of Medicine*, 1855, p. 624) thinks he has seen inhalation of the finely-levigated powders of cinchona, and the acetate of lead, useful in restraining profuse expectoration.

Prof. R. H. THOMAS, of Baltimore, recommends (*Transactions of the American Medical Association*, 1855, vol. viii, p. 591, with cut) to the notice of the profession the following simple and easy method of applying nitrate of silver to the air-passages, contrived and adopted by his brother, Dr. John Chew Thomas, of Baltimore.

Let a fine grindstone or emery-wheel be caused to revolve with great velocity, while a stick of the caustic is lightly held in contact with it. The effect will be to convert the caustic into an impalpable powder, which may be inhaled freely by the patient, who sits before the stone at a convenient distance ; from three to six or eight inhalations may be taken at a sitting, according to the effects, but it is recommended to desist after much cough is created, and the operation may be repeated every two or three days, according to the influence it exerts on the disease.

It has been found, in Dr. Thomas's experience, to be well adapted to chronic inflammation of the larynx, trachea, and bronchi, rarely causing any more than a temporary irritation. He has also used it with good effect in recent hoarseness and slight inflammation of the fauces and throat. In established acute inflammation, depletion and general treatment should precede its employment.

Dr. Thomas refers to a number of instances of slight but persistent affections of the larynx and trachea, which were accompanied with weakness of voice, hoarseness, inability to speak or read for any length of time, which were entirely cured by the use of this means ; also cases of chronic bronchitis, which had proved very obstinate, yielding perfectly to the steady use of the same

agency. He does not claim that it can supersede the use of the sponge and caustic solution, but that in many of the slighter affections of the throat, it may enable us to dispense with the disagreeable necessity of using the mop, and that it is applicable to some cases to which the former method is not.

Prof. CHAS. MATTHEWS describes and depicts (*Am. Med. Times*, November 24, 1860, p. 365) an instrument of his invention, intended to facilitate the inhalation of the smoke of powders in a state of ignition. It consists of two tubes of paper, to the outer of which is attached the mouth-piece, the powder being confined within the inner tube, upon lighting which the smoke is conveyed to the mouth through the interspace between the two tubes. Cubebs is preferred as the vehicle to give sufficient volume to the powder when employed in this manner, for cases where a gentle stimulus is desired; though decayed wood, pine bark, &c., may be employed for the purpose.

An important point to be determined, says Lewin (*op. cit.*, p. 122), in this connection, is whether the powder inspired remains in the respiratory tract, and is not again extruded by the waving outwards of the ciliary epithelium. That this latter occurrence is generally the case, continues Lewin, we know very well. A large quantity of minute dust is continually floating in the atmosphere, especially in crowded cities. Now, if all this were inhaled, and remained in the pulmonary organs, it would eventually produce fatal consequences, because the bronchial tubes would become more or less clogged up. Such a result, however, is avoided by our natural instinct of breathing through the nostrils, the tortuous sinuosities (from the shape of the turbinated bones) of which

cavities, are provided with small hairs; these hairs and the turbinated prominences catch the particles of dust inhaled through the nostrils, which particles are subsequently ejected from time to time by a very familiar process. But after a certain number of nasal inspirations, we find it necessary to gape or take a deeper inspiration than ordinary, for which purpose the mouth is more or less widely opened; usually it is not very widely opened, and the soft palate not being raised very much, the dust taken in with the inspiration strikes the velum, and becoming entangled in its mucus, it is thrown upon the moist mucous membrane of the tongue, half arches, and pharynx; the dust that has proceeded farther, is arrested by the epiglottis, the ary-epiglottic folds, and the ventricular bands or false vocal cords. If, notwithstanding these hindrances, some of the dust reaches the larynx or trachea, it is detained by the moist mucous membrane, and is expectorated by hawking or coughing, or is gradually removed by the waving of the cilia.

This is much less the case, and in some instances not at all the case, when the materials inhaled are soluble, and dissolve in the bronchial mucus before the cilia can extrude them; or when the matters are specifically too heavy to be moved by them; or when too great a quantity has been inhaled; or when the mucous membrane does not possess its full strength and capabilities.

On these grounds, concludes Lewin, it would appear that the inhalation of powders can be employed for the purposes of local therapeutics.

## CHAPTER II.

### EXPERIMENTS ON MEN AND ANIMALS, PROVING THE PENETRATION OF POWDERS INTO THE RESPIRATORY TRACTS.

ANY one can convince himself that powders can be voluntarily drawn at least into the upper air-passages, by directing the dust of some colored substance, as charcoal, for instance, across his mouth, and suddenly taking a deep inspiration. The irritation produced, and the spasm of cough accompanying it, will be proof positive that some of the suspended particles have been drawn beyond the glottis, while an examination with the laryngoscope will show that some particles of the dust have lodged upon the vocal cords, true and false, the greater proportion being spread on the anterior wall of the trachea, and very little reaching the posterior walls of the larynx. A large portion of the powder will, of course, have remained in the mouth, principally detained about the base of the tongue, and upon the soft palate just over the attachment of the uvula.

A great many experiments have been made upon animals who were forced to inhale powders, and in whom, after section, the presence of the powders has been demonstrated in the respiratory organs.

The principal experimenter in this direction has been FOURNIÉ, and his reports have excited a good deal of attention among those interested in the question.

In the *British & Foreign Medico-Chirurgical Review*, July, 1863, p. 241, we read: "Dr. EDOUARD FOURNIÉ (*L'Union Médicale*, February 5, 1863) has clearly ascertained that the dust of charcoal, flint, starch, &c., penetrates into the bronchi, and he has endeavored to render the fact available in the treatment of disease. In order to obviate any disagreeable sensation on the part of the patient, he recommends the medicinal powder to be breathed in a special contrivance which he describes. It consists of an oval wooden box, fitted with two tubes, so arranged that the patient breathes the air in the box mingled with the medicinal powder. Laryngoscopic examination, and the black expectoration after the use of the apparatus, when charcoal-dust has been employed, proves that the dust has entered the respiratory passages. The same apparatus is available for the inspiration of volatilized iodine, and Dr. Fournié has also thus employed for medicinal purposes, starch, alum, tannin, subacetate of lead, and nitrate of silver. The diseases which he has successfully treated have been cases of catarrh, bronchitis, and some of well-marked phthisis."

Fournié inclosed the head of a coal-heaver, whose nostrils were first compressed by forceps (*pince-nez*), in a sack filled with a quantity of coal-dust, and then the sack was shaken over his head with a good deal of force. The man coughed and coughed, and seemed to feel very uncomfortable. After being allowed to breathe this atmosphere for three minutes, the sack was removed and an examination by the laryngoscope gave the following result: The tongue, soft palate, tonsils, and pharynx, were fully covered with a thick layer of coal-dust; the epiglottis, aryteno-epiglottic ligaments, and the aryte-



noid cartilages, were marked with coal streaks at several places, and were very much reddened; there was only a thin black streak over the right vocal cord. An examination with the laryngoscope before the experiment, had shown the parts to be normal. This cleanness of the mucous membrane of the larynx contrasted very strongly with the condition of the trachea, the mucous membrane of which, particularly on its posterior wall, was almost entirely covered with coal-dust. This experiment was repeated by Fournié upon himself and others, with similar results. (Lewin, *op. cit.*, p. 121.)

Quite recently, Dr. MORITZ ROSENTHAL, of Vienna, has published the records of a series of experiments which he instituted upon rabbits to determine the extent to which pulverulent substances could be made to penetrate into the respiratory organs (*Schmidt's Jahrbücher*, November, 1866, from *Wien. Zeitschrift*, 1866, No. 1). Some very finely-pulverized charcoal, sifted through a cloth, was placed in a double linen bag, in which a moderately-sized rabbit was confined, and the bag, with its contents, was then whirled round for from fifteen to twenty minutes, after which the animal was killed by section of the spinal cord, and the respiratory tract examined from below upwards, to avoid the conveyance by the shears of any of the material from above downwards. The coal was found in the ventricles of the larynx, on the walls of the trachea, and on those of the larger bronchi. By the aid of a lens, it was detected in the interstitial lung-tissue, where it became still more evident upon microscopical examination. Sufficient reasons are adduced to prove that the appearances were not due to the pigment matter normally found in the lung-tissue of such animals. An animal which had been permitted

to live for several days after having been similarly exposed to an atmosphere loaded with the charcoal-dust, was examined, but not a particle of coal was found in the larynx or trachea, although such particles were discovered under the microscope in various portions of the lung, and also imbedded in the muscular structure of the right ventricle of the heart, into which they had bored their way ; not, however, in that of the left ventricle. Another rabbit was compelled to breathe a mixture of coal and starch powder, for fifteen minutes, immediately after which it was killed, but afforded no evidence of starch, microscopically or chemically, in the lungs or in any other organ ; the starch had been detained in the mucus of the upper part of the air-passages. A large rabbit was made to breathe for twenty minutes an atmosphere in which was suspended six ounces of carbonate of lead. Evidences of the lead were found in the larynx, trachea, and main bronchi ; and the lung-tissue, when dried under the microscope, showed irregular masses of crystals, identical with those of the carbonate of lead.

Dr. ROSENTHAL found that in foundries, where the models are sprinkled all over with graphite before being cast, the sputa of the workmen were black-colored and somewhat greasy. On laryngoscopic examination, he found stripes of grayish-black dust collected upon the posterior pharyngeal wall, and also upon the epiglottis and the vocal cords, the mucous membrane covering which structures was greatly reddened. These workmen are well nourished as a general rule, not liable to pulmonary affections particularly, and tuberculosis among them is rare. The irritation from the inhaled graphite seems principally confined to the pharynx,

larynx, and upper portion of the trachea. The writer then goes on to recount the effect of various occupations, where the atmosphere of the workroom is filled with dust, as those of bakers, grinders, apothecaries, &c.; he believes that very often such substances inhaled, by keeping up a continued irritation of the bronchial mucous membrane, &c., affect the distributions of the vagus, recurrent, and hypoglossal nerves; at times, even to the extent of producing paralysis.

The investigation into the diseases to which workers in stone, glass, tobacco, coal, &c., are subjected, by Traube, Cohnheim, Leuthold, Kussman, Degen, Zenker, Selbman, Koschlakoff, Felbz, and many other Teutonic physicians who have given the subject great attention, prove, beyond the possibility of a doubt, that fine particles of dust gain entrance into the air-passages, inducing severe and often fatal affections.

## CHAPTER III.

### PATHOLOGICAL PROOFS OF THE PENETRATION OF POWDERS INTO THE LUNG-TISSUE.

A CASE proving the penetration of particles of coal into the lung-tissue, from inhaling an atmosphere loaded with the substance, is reported in detail by Prof. TRAUBE (*Deutsche Klinik*, 1860, Nos. 49 and 50, pp. 2 to 3½). This case was a charcoal carrier, æt. 54, who had worked at his employment for twelve years, and in whose lungs, after death, particles of charcoal were detected (*Schmidt's Jahrbücher*, vol. 110, p. 299). For twenty years he had had a cough, and of late years had suffered with shortness of breath. For twelve years, and to within the last three months of his life, he had been almost constantly exposed to the dust of charcoal, and had often observed that his sputa were black. In his expectoration were found numerous free black particles, of very irregular, angular shape, and sometimes of large size. Some of these presented structural peculiarities identifying them with the wood of the *Pinus sylvestris*. Three months before his death he was attacked with pericarditis, and subsequently, double pleuritis, and finally, gangrenous erysipelas. At the autopsy, the lungs were found free from structural lesion, but almost everywhere of a dark black color. A copious amount of dark serous fluid exuded on pressure, staining the fingers black like India-ink, and exhibiting

under the microscope black and red particles similar to those which had been found in the sputa. Some of these particles were firmly imbedded in the pulmonary cells, to which they had bored their way. Prof. Traube believes that derangement of the ciliary action of the bronchial mucous membrane is essential to the accumulation of carbonaceous matter in the lungs, inasmuch as many persons continually inhale fine dust in similarly loaded atmospheres without apparent suffering.

A similar case occurring in Prof. Traube's Klinik is reported by Dr. LEUTHOLD, in the *Berlinen Klinik Wochenschrift*, iii, 3, 1866 (*Schmidt's Jahrbücher*, Band 132, 1866, p. 163), in which, during life, the particles of the coal were detected in the sputa upon microscopical examination; and at the autopsy, Dr. COHNHEIM detected similar particles in the very stroma of the lungs, and in the bronchial glands, proving that they had penetrated into the air-cells and had bored their way through the walls of the alveolæ.

Dr. PEACOCK reports (*Brit. and For. Medico-Chirurgical Review*, vol. xxv, 1860) the results of a post-mortem examination of a patient who died of millstone-makers' phthisis, at the age of thirty-seven, having commenced work at that trade in his twentieth year. Portions of the indurated pulmonary tissue, and of the diseased bronchial glands, were obligingly examined by Dr. BRISTOWE, who furnished the reporter with the following notes: "The diseased portions of lung were much indurated, having generally an opaque whitish hue, but being thickly studded with a black pigment. Under the microscope little or no trace of original lung-structure was visible, but the diseased masses appear to be made up of dense, closely-arranged, fibroid tissue,

studded here and there with numerous irregular groups of black pigment, and generally with an abundance of transparent granules and globules of various sizes. The tissues were rendered comparatively transparent under the influence of strong acetic acid, the fibroid tissue becoming a little expanded, and many of the granules and globules disappearing. The bronchial gland presented characters identical with those of the diseased lung."

Dr. PEACOCK subjected portions of the indurated lung-tissue to ignition in the flame of a spirit-lamp. The white ash which remained, dissolved to a great extent in hydrochloric acid, and partly with effervescence; but a portion was left which was seen under the microscope to consist of small angular transparent granules, exactly resembling the finer portions of the silicious dust collected from one of the workshops. Dr. MOLDENHAUER, assistant in the chemical laboratory at St. Thomas' Hospital, also subjected portions of the indurated lung to the action of fire and nitric acid, and found that a considerable quantity of gritty matter remained, which had an amorphous aspect under the microscope, and was inferred to be silicious. The bronchial gland did not contain any similar material.

At a meeting of the Pathological Society of London, held May 16th, 1865, Dr. GREENHOW exhibited two morbid pathological specimens, one being a specimen of diseased lungs from a case of grinders' asthma, and the other a specimen of coal-miners' black lung. To copy the account from the Transactions of the Society:

*"Specimen of diseased lung from a case of grinders' asthma.*—The specimen has been in my possession for some years. It was taken from the body of a razor-

grinder, who had long suffered from grinders' pulmonary disease, but had died from an intercurrent attack of pneumonia. The portion of lung shown is from the upper lobe, near the apex; it is consolidated, but some parts are harder than others, and it is intersected by a firm white band, apparently produced by the thickening of interlobular tissue. It is now of a dark bluish-gray color, but is paler than when fresh. On examination of a thin slice under the microscope, a few small, apparently crystalline bodies, irregular in size and shape, were seen embedded in the tissue, which also contained numerous small, well-defined, black masses of various sizes, which gave the lung its peculiar dark color. On the supposition that these latter might be at least due to the presence of oxidized iron, a very thin slice of the lung was taken and immersed for some time in hydrochloric acid; but on examination under the microscope, it was found still to present appearances identical with those already described. In order to determine the nature of the apparently crystalline bodies, a small portion of the lung was carefully incinerated in a porcelain crucible; it left a bright red ash which partially dissolved in boiling hydrochloric acid, leaving a small residue that gravitated to the bottom of the vessel. On examination of this residue under the microscope, it was found to consist partly of an amorphous deposit, partly of small angular masses which reflected light powerfully, and polarized light transmitted through them. A portion of the residue being, at the suggestion of my friend, Mr. HEISCH, lecturer on chemistry at the Middlesex Hospital, exposed in a shallow platinum vessel to the fumes of hydrofluoric acid, was entirely dissipated, proving it to be silica. A

comparative experiment was tried with a portion of ordinary lung (from a patient who had died in the Middlesex Hospital) which, when incinerated, left an ash not quite so red as that from the grinder's lung, and altogether soluble in boiling hydrochloric acid. The solution of the ash from both lungs gave faint indications of the existence of iron, about equal in both cases; but the absence of free particles of iron in the grinder's lung was determined by bringing every part of the specimen into proximity with a delicate magnetic needle without causing any sensible disturbance.

“The disease from which the patient had suffered appears to have been chronic, or, as Rokitansky terms it, interstitial pneumonia, and its cause was doubtless the inhalation of finely pulverized grit, given off from the revolving grindstone while the man was at work, and which, as we have seen, was found in the lung after death, in the form of small angular particles of silica.

“*Specimen of coal-miners' black lung.*—This specimen, like the former, has been in my possession for some time. It was obtained from the body of a collier who had worked in the shallow and ill-ventilated coal mines near Wolverhampton, and was taken from the free margin of the upper lobe. The general color of the mass is dark blue, almost black; but it was quite black when fresh, at which time a black juice could readily be expressed from its substance. The pleura is thickened, and the lung is traversed by some firm white bands, apparently formed by the thickening of the interlobular tissue. The lung cuts toughly, and is very firm and solid, but not uniformly so, some ill-defined harder portions being felt in the substance when handled. Under the microscope, the lung was seen to be studded with



small black deposits, apparently irregular, both in shape and size, but the examination was not made until it had been for some time immersed in spirit. On boiling a small slice in strong hydrochloric acid, the black deposit was not affected. A portion of the lung when incinerated, left a red ash, closely resembling the ash left from burnt coal. When boiled in hydrochloric acid, this ash was partially dissolved, leaving a white or grayish amorphous residue, which did not polarize light, but evidently consisted of silica, for it was dissipated on being exposed to the fumes of hydrofluoric acid.

“This case appears to have been assimilated in its pathological characters to that of the razor-grinder. The lung was similarly consolidated, and traversed by white bands. *Whatever doubt may sometimes be entertained regarding the origin of the black deposit in the lungs of colliers, it appears quite certain that in this instance it arose mainly from the inhalation of finely-pulverized coal; for on no other supposition can we explain the presence of the very large amount of amorphous silica obtained from the incinerated lung.*

“REMARKS.—The result of the examination of these specimens of lung accords with the history of the symptoms from which the several classes of operatives exposed to inhale grit, or other heavy dust, are practically found to suffer. The earlier symptoms are those of bronchial irritation, namely: slight dyspnœa, cough, and scanty expectoration colored with the material inhaled. This ailment often proceeds so slowly and insidiously that the sufferer is scarcely aware of its existence until it becomes aggravated by some attack of catarrh, and more or less disables him from working. Hence, overlooking the previous indisposition, he, for

the most part, dates the commencement of his illness from the occurrence of a cold. In a great many instances, and especially those in which the dust inhaled is of a light description, the disease often remains bronchial throughout, and presents only the ordinary characters of chronic bronchitis, with or without emphysema. But in other cases, and especially in those in which a heavy dust, such as that given off in the processes of razor-grinding or china-scouring, has been inhaled, chronic pneumonia supervenes after a time, and frequently proves fatal, either in consequence of an intercurrent attack of acute pneumonia, or after a long chronic course with symptoms resembling those of very chronic phthisis. Dyspnœa is always a very marked feature of such cases, and is sometimes so extreme as to prevent active locomotion, even while the patient is still able to continue his occupation. The physical signs are also out of all proportion to the amount of disturbance of the general health, which, in constitutionally sound subjects, is much less than in those who are the subjects of pulmonary disease arising from constitutional cachexia. Sometimes, even when the complaint appears to be far advanced, the discontinuance of exposure to the determined cause, viz., the inhalation of dust, is followed by a most marked improvement in health."

Prof. ZENKER relates in detail (*Deutsch. Arch. für Klinik Med.*, 1866, vol. 11, p. 116) a case of an operative, æt. 31, who had been employed during life in preparing the paper books for the gold-leaf fabric, and who died in 1864, after an illness of eight weeks. The powder employed is that known as English red, a compound of iron, which is used in the form of a dry impalpable powder, and rubbed into the paper with felt. The atmos-

phere of the workroom becomes so filled with the dust as, in a few minutes, to dry the fauces of strangers unaccustomed to the atmosphere. The lung of this patient had a red color; and on chemical examination, Prof. von GORUP-BESANEZ found oxide of iron in large quantities as fine molecules in the air-passages, and to a greater extent in the lung-tissue itself; besides, also, in the bronchial glands; and still further, showing that the particles, after penetrating the interstitial tissue, had been carried onwards by the lymphatic system.

A solution, in hydrochloric acid, of 55 grammes of the incinerated ash of this lung-tissue, was found to contain 0.828 grammes of oxide of iron; therefore, 14.5 grammes, or about half an ounce to 1000 grammes; or in the proportion of three-fourths of an ounce in the entire lungs, which, in the present instance, weighed 1500 grammes, the left lung weighing 720, and the right 780 grammes; much in excess of the normal weight of the female lungs, which, according to Krause, is 1050, according to Dieberg, 1073 grammes.

In order to determine the specific gravity, a comparative experiment was made with the healthy lung of a robust man of forty years of age, who died of another affection, and with the compressed lung of an old man, who died of pleuritic exudation, care being taken to remove by frequent washing, &c., all sources of error which might invalidate the experiment. The result is shown in the following table:

	A portion of the oxidized lung;	Of the sound lung;	Of the compressed lung;
Weighed in air, . . . . .	7.210 gr.	8.810 gr.	12.02 gr.
Weighed in water, . . . . .	0.440	0.130	0.03
Loss of weight in water, . .	6.770	8.680	11.99
The sp. gr. being . . . . .	1.065	1.015	1.0025

To demonstrate more clearly the increased weight, equal portions were taken from the above specimens, and also from the sound lung of a boy of fifteen years of age, which were allowed to drop to the bottom of a glass cylinder, filled with water to the height of forty-five centimetres; when it was found that the oxidized lung fell in thirteen seconds, upon a first, second, and third trial; that the piece of sound lung from the robust man aged forty, fell in twenty-six seconds on the first trial, in twenty-five seconds on the second trial, and in twenty-six seconds on the third trial; the piece of sound lung from the boy aged fifteen, fell in thirty seconds on the first and second trials; and the specimen of compressed lung from an aged man fell in thirty-one seconds on the first trial, in thirty-two seconds on the second trial, and in thirty-two seconds on the third trial.

A second case is related with similar results as to the detection of oxide of iron in the air-passages and lung-tissue, in a patient who had been employed backing glass mirrors, the English red being used for the purpose of rendering the metal adherent.

The sputa of a similar operative, examined twelve hours after leaving off work, were found to contain the oxide of iron upon chemical and microscopical investigation.

The results of many other post-mortem examinations have given the same results. Thus may be mentioned the cases recorded by ERDMANN, LÆWE, BROCKMAN, PEARSON, BICHAT, TROUSSEAU, LAENNEC, and many others.

Dr. L. PETRENZ (Lewin, *op. cit.*, p. 11) found stony concretions the size of a hazel-nut in purulent pulmonary cavities.

With regard to the black pigmentary matters found in the lungs of deceased coal-miners, and others who have worked in atmospheres loaded with coal-dust, some authors deny altogether their penetration into the pulmonary organs; others contend that they may be inhaled, but, being insoluble, are expectorated; others not only admit their penetration, but are of opinion that they accumulate, act deleteriously, and produce alteration of structure.

VIRCHOW is one of those who contend that these appearances are not due to the inhalation of particles of coal-dust; which, according to him, if inhaled, would be extruded with the bronchial mucus. He considers the affection pigmentary, and due principally to obstruction of the mitral valve dependent upon a chronic hyperæmia of the lungs, the result of a detention of the blood in the pulmonary veins.

BAYLE recorded two cases which he attributed to a circumscribed melanosis; and LAENNEC, in commenting upon this view, rather refers the black deposit, as at least in part due, to inhalation from the smoke of the lamp or other products of illumination in general use, as it was sometimes discovered in the lungs of nurses accustomed to sit up at night with the sick.

It is also found in the lungs of other miners, not colliers, who work with lamps suspended over their heads.

Others, again, are of opinion that the carbonaceous material or lampblack thus inhaled, accumulating, forms a nidus for the attraction of further carbonaceous matter from the blood. This view seems to be worthy of a good deal of consideration, for it has been found that by washing the lungs containing such deposits, two

materials are secured—one a vegetable carbon not acted upon by the solvents which will readily dissolve the other or organic pigmentary matter.

While it is true that much of the matters inhaled would be thrown out of the system with the bronchial secretions, it must be remembered that some portions will be too heavy to be cast out against gravity, by the mere motion of the bronchial cilia, while other minute sharp-pointed particles, will bore their way through the epithelium, and thus eventually become embedded into the very pulmonary tissue, as indeed appears to have been the case in the examples cited, similar evidence to which can be readily increased by adducing further records.

We know, too, that workmen who remain long at a time in apartments filled with fine dust,—for instance, bakers, weavers, chimney-sweepers, artificers in stone, &c.,—are peculiarly liable to diseases of the lungs. Thus Dr. PEACOCK, calling attention (*Brit. & For. Med.-Chir. Rev.*, vol. xxv, 1860, p. 215) to the form of phthisis to which the French millstone-makers are subject, explains how it is contracted. The rough working of the stone is effected by a steel chisel, “the pritchel,” which is struck by a metal hammer, and the surfaces are finished by picking with a double-pointed steel instrument fixed in a wooden handle—the “bill and thrift.” As the burr is extremely hard (it is the “French burr,” situated in the Paris basin above the gypsum containing bones, and in strata of sand and sandstone, and is harder to work than gun-flint), every stroke of the chisel is attended by a flash of light and a cloud of dust, and larger or smaller particles of stone, forming a sharp grit, are thrown off. Portions of the stone and of iron from the chisel not in-

frequently become embedded in the hands of the workmen, so that the backs of the hands of those who have been long at the trade are studded with small bluish spots; and occasionally the men sustain serious injury to their eyes. The mortality of these workmen is very great, so that of fifty workmen, about twenty will die of pulmonary disease within a few years, and they seldom live beyond forty years of age, especially if they begin to work at the trade in early life before their full physical development has been acquired. Dr. Peacock found in four workshops forty-one workmen, of whom the eldest was but thirty-eight years of age, and those next oldest twenty-nine and twenty-eight respectively. Most of them had before them, on an average, but eight or nine years more of labor. It is a remarkable fact that these workmen, knowing their condition and the result of a continuance at their avocation, seem thoroughly satisfied with it. Their wages are high (5s. per day), their dwellings and workshops are healthy, and they are well clothed. They drink freely of ardent spirits, which is said to preserve their strength and enable them to exist longer.

Prof. DICKSON, in his lectures last winter in Jefferson Medical College, Philadelphia, teaching the causation of disease, drew the attention of his class to the fact that many diseases are necessary results of the occupations of civilized life, and instanced the wet and dry grinders in England, who have long been doomed to premature old age and death, from the wearing away of the stone in "foam-like surges," which fill the lungs and thus induce fatal disease; for a dry grinder rarely reaches thirty-five, or a wet grinder forty-five years of age; quoting the following lines from *Elliot's Corn-Law*

*Rhymes*, showing how these grinders, like the millstone-makers, continue at their trade on account of its high wages and opportunity for affording the means of alcoholic stimulation :

“ There draws the grinder his laborious breath ;  
 There, coughing, at his deadly trade he bends ;  
 Born to die young, he fears nor man nor death ;  
 Despair and riot are his bosom friends.  
 Bid science on his cheek prolong the bloom !  
*He will* not live—he seems in haste to gain  
 The undisturbed asylum of the tomb ;  
 And, old at two-and-thirty, meets his doom.”

As a pathological proof of the penetrability of fine powders into the respiratory passages, I may instance a number of cases occurring in a family in this city living over a perfumery store which caught fire. The family breathed the stifling smoke, and ten of them who came under the care of Dr. W. W. Keen, Jr., and myself, were attacked with severe bronchitis, with aphonia ; and for several days subsequent to the accident they expectorated large quantities of black sputa, which were nothing more nor less than the carbonaceous matters they were forced to inhale during the conflagration before they could be rescued.

Dr. DA COSTA, of this city, in a foot-note to the reprint of his lately-published essay on Inhalation, states that quite recently his attention had been called by Dr. Fleming, of Pittsburg, to the rapidity with which men repairing copper work which had been used for steam, water, &c., become affected by the impalpable oxide of copper therein formed. Dr. Fleming himself, having been exposed for a few minutes to the same influence, and the quantity breathed having been very minute, was astonished at the great effect experienced ; constriction about the chest, most active salivation, &c.



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